PB90-178120

Superfund Record of Decision (EPA Region 5): Ionia City Landfill, Ionia, Michigan (First Remedial Action, September 1989)

(U.S.) Environmental Protection Agency, Washington, DC

29 Sep 89

U.S. Department of Commerce
National Technical Information Service
NTIS

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R05-89/105
September 1989

PB90-178120

EPA

Superfund Record of Decision:

Ionia City Landfill, MI

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R05-89/105	2.	3. Recipient's Accession No. PB 90 178120/AS
4. Title and Subtitle SUPERFUND RECORD OF DECISION Ionia City Landfill, MI First Remedial Action			5. Report Date 09/29/89 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization Name and Address			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460			13. Type of Report & Period Covered 800/000 14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The Ionia City Landfill site is a 20-acre municipally owned landfill in the southeast corner of Ionia, Michigan. The site is bordered by the Grand River to the south, a tributary to the Grand River to the east, and a light commercial/residential area to the north. The site lies within the 100-year floodplain of the Grand River. The landfill was operated from the 1950s until about 1969, during which time industrial, commercial, and municipal wastes were disposed of at the site, including drummed liquids and solids from industrial sources. Drums of ignitable liquid wastes were reportedly burned until 1965. A State investigation in 1981 revealed exposed drums containing paint wastes, thinners, and industrial solvents as well as elevated levels of metals. Furthermore VOC- and metal-contaminated ground water was detected. EPA investigations began in 1982 and revealed VOC contamination in the Grand River tributary surface water. Follow-up investigations by EPA led to an immediate removal action in 1984-85 by the city, under an administrative order, which included fencing a portion of the site, removing and disposing of exposed drums, covering depressed areas, and stabilizing areas of erosion. Current site risks result from subsurface wastes (or point source) from a 1/4 acre area in the northern section of the landfill. The estimated total waste volume is 5,000 cubic yards consisting of badly deteriorated buried drums and associated wastes, and contaminated soil. In addition there is a contaminant plume in an underlying shallow aquifer. The first operable unit addresses the point source (Continued on next page)

17. Document Analysis a. Descriptors

Record of Decision - Ionia City Landfill, MI
First Remedial Action
Contaminated Media: soil, debris
Key Contaminants: VOCs, other organics, metals (chromium)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 60
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

DO NOT PRINT THESE INSTRUCTIONS AS A PAGE IN A REPORT

INSTRUCTIONS

Optional Form 272, Report Documentation Page is based on Guidelines for Format and Production of Scientific and Technical Reports, ANSI Z39.18–1974 available from American National Standards Institute, 1430 Broadway, New York, New York 10018. Each separately bound report—for example, each volume in a multivolume set—shall have its unique Report Documentation Page.

1. Report Number. Each individually bound report shall carry a unique alphanumeric designation assigned by the performing organization or provided by the sponsoring organization in accordance with American National Standard ANSI Z39.23–1974, Technical Report Number (STRN). For registration of report code, contact NTIS Report Number Clearinghouse, Springfield, VA 22161. Use uppercase letters, Arabic numerals, slashes, and hyphens only, as in the following examples: FASEB/NS–75/87 and FAA/RD–75/09.
2. Leave blank.
3. Recipient's Accession Number. Reserved for use by each report recipient.
4. Title and Subtitle. Title should indicate clearly and briefly the subject coverage of the report, subordinate subtitle to the main title. When a report is prepared in more than one volume, repeat the primary title, add volume number and include subtitle for the specific volume.
5. Report Date. Each report shall carry a date indicating at least month and year. Indicate the basis on which it was selected (e.g., date of issue, date of approval, date of preparation, date published).
6. Sponsoring Agency Code. Leave blank.
7. Author(s). Give name(s) in conventional order (e.g., John R. Doe, or J. Robert Doe). List author's affiliation if it differs from the performing organization.
8. Performing organization Report Number. Insert if performing organizaton wishes to assign this number.
9. Performing Organization Name and Mailing Address. Give name, street, city, state, and ZIP code. List no more than two levels of an organizational hierachy. Display the name of the organization exactly as it should appear in Government indexes such as Government Reports Announcements & Index (GRA & I).
10. Project/Task/Work Unit Number. Use the project, task and work unit numbers under which the report was prepared.
11. Contract/Grant Number. Insert contract or grant number under which report was prepared.
12. Sponsoring Agency Name and Mailing Address. Include ZIP code. Cite main sponsors.
13. Type of Report and Period Covered. State interim, final, etc., and, if applicable, inclusive dates.
14. Performing Organization Code. Leave blank.
15. Supplementary Notes. Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of . . . Presented at conference of . . . To be published in . . . When a report is revised, include a statement whether the new report supersedes or supplements the older report.
16. Abstract. Include a brief (200 words or less) factual summary of the most significant information contained in the report. If the report contains a significant bibliography or literature survey, mention it here.
17. Document Analysis. (a). Descriptors. Select from the Thesaurus of Engineering and Scientific Terms the proper authorized terms that identify the major concept of the research and are sufficiently specific and precise to be used as index entries for cataloging.

    (b). Identifiers and Open-Ended Terms. Use identifiers for project names, code names. equipment designators, etc. Use open-ended terms written in descriptor form for those subjects for which no descriptor exists.

    (c). COSATI Field/Group. Field and Group assignments are to be taken form the 1964 COSATI Subject Category List. Since the majority of documents are multidisciplinary in nature, the primary Field/Group assignment(s) will be the specific discipline, area of human endeavor, or type of physical object. The application(s) will be cross-referenced with secondary Field/Group assignments that will follow the primary posting(s).
18. Distribution Statement. Denote public releasability, for example "Release unlimited", or limitation for reasons other than security. Cite any availability to the public, with address, order number and price, if known.

19. & 20. Security Classification. Enter U.S. Security Classification in accordance with U. S. Security Regulations (i.e., UNCLASSIFIED).

21. Number of pages. Insert the total number of pages, including introductory pages, but excluding distribution list, if any.

22. Price. Enter price in paper copy (PC) and/or microfiche (MF) if known.

☆ GPO : 1983 O - 381-526 (8393)

16. Abstract (Continued)

area. A second operable unit addressing ground water has been deferred until the completion of the ground water monitoring plan. The primary contaminants of concern affecting the soil and debris are VOCs including vinyl chloride and methyl chloride, other organics, and metals including chromium.

The selected remedial action for this site includes in situ vitrification of the defined point source area and an adjacent margin of safety zone, including an off-gas collection and treatment system; access restrictions; ground water monitoring; institutional controls to restrict site use; and upgrading the landfill cover and repairing the side slopes followed by revegetation. The estimated present worth cost for this remedial action is $3,630,525, which includes an estimated annual O&M cost of $112,750 for year 1 and $51,000 for years 2-10. If a pilot test indicates that the selected remedy is inadequate, a contingency alternative of partial excavation with onsite incineration will be implemented.

OPERABLE UNIT RECORD OF DECISION
SELECTED SOURCE CONTROL REMEDIAL ALTERNATIVE

Site Name and Location:

The Ionia City Landfill occupies approximately 20 acres in the southeast corner of Ionia, Michigan.

Statement of Basis and Purpose:

This decision document presents the selected source control remedial action for the Ionia City Landfill, located in Ionia, Michigan. This decision has been developed in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Contingency Plan. This decision is based on the administrative record for the Site. The attached index identifies the items that comprise the administrative record upon which the selection of the source control remedial action is based.

The State of Michigan has concurred with the selected source control remedy. The letter of concurrence is attached to the Record of Decision (ROD) package.

Description of the Selected Remedy:

The selected source control remedy is an operable unit that addresses the principal threat posed by the Site. The major components of the selected source control remedy include:

* In-situ vitrification (ISV) of the defined point source area and an adjacent margin of safety zone;

* fencing the Site to restrict access (repairing the fence in Area A and installing a fence along Cleveland Street in Area B);

* placement of at least 3 monitoring wells in the shallow A-1 aquifer immediately downgradient of the point source area to assess completeness of point source remediation and monitor future release, if any, of contaminants to the groundwater from the point source;

* institutional controls to restrict the use of the Site and, if appropriate, adjacent properties, from activities that would potentially endanger public health or threaten the environment; and,

* upgrading the landfill cover and repairing the side slopes, as needed, followed by revegetation to minimize future erosion and insure integrity of the landfill cap.

Full scale implementation of ISV is contingent on successful on-site implementation of pilot test that insures ISV's applicability to existing site conditions. In the event the selected alternative will not provide the necessary level of remediation, as documented by the pilot test, U.S. EPA intends to implement the contingency source control remedial alternative, partial excavation with on-site incineration, after the appropriate Agency guidance has been followed.

Groundwater monitoring is a critical component of the selected source control remedy and will be conducted to: assure point source remediation is complete; monitor the migration of residual contamination in the groundwater; and verify the assumption that no further source areas exist within the landfill. A decision on further groundwater action is deferred until completion of the nine month groundwater monitoring program following point source remediation. This will culminate in a ROD that will address the groundwater operable unit, which in conjunction with this Source Control ROD, constitutes the final remedy for the Site.

Declaration:

The selected source control remedy is protective of human health and the environment, and attains Federal and State requirements that are applicable or relevant and appropriate for the remedial action. The source control remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the Site. The source control remedy for the Site utilizes treatment as a principal element of the remedy, as per the statutory preference. If there is no remediation of the point source, there will continue to be an actual or potential imminent and substantial endangerment to human health, welfare and the environment.

Sept. 29, 1989
Date

Valdas V. Adamkus
Regional Administrator

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

IONIA CITY LANDFILL, IONIA, MICHIGAN

I. SITE NAME, LOCATION AND DESCRIPTION

The Ionia City Landfill, hereinafter referred to as the Site, is owned by the City of Ionia and is located in the southeast corner of the City of Ionia, Michigan, approximately 30 miles east of Grand Rapids, (Figure 1). The Site occupies approximately 20 acres in the eastern one-half of the southwest quarter of Section 20, Township 7 North, Range 6 West, Ionia County, Michigan. The Site is bordered by Cleveland Street to the west, the Grand River to the south, a tributary of the Grand River to the east and a light commercial/residential area to the north (Figure 2). The Grand River is a sport fishing and recreational river in the State of Michigan.

The Site is situated within the Grand River valley. The landfill is surrounded by relatively steep slopes on its northeast, east and south sides. There is also a steep slope on the west side of Cleveland Street which drops 10 to 15 feet onto adjacent farmland. The slope is not evenly graded which may be the result of early road construction and subsequent erosion. The bridge over the Grand River was reportedly replaced during the mid- to late-1950s.

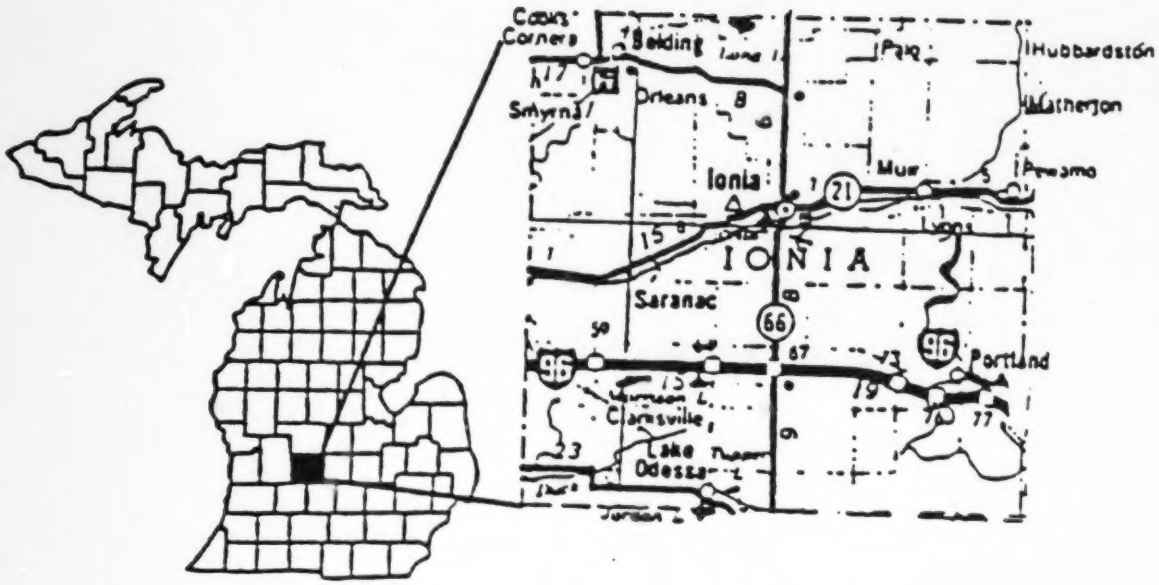
The Site is generally flat and divided into two areas, A and B, which are both elevated 10 to 15 feet above the adjacent floodplain and Grand River. Area A is an older fill area comprising the northern portion of the Site. Area B is a southern more recent fill area. Area A and B are separated by the former location of Chesapeake & Ohio Railroad tracks which were removed in 1987. Area A is enclosed by a six-foot high chain link fence which was constructed in August 1984. The fence is topped with barbed wire and has an entrance gate with posted warning signs at Cleveland Street. Area B is not fenced; however, access is discouraged by earthen berms and wooden posts. Generally, the Site has a good vegetative cover of grasses and shrubs with wooded areas along the banks of the east tributary and the Grand River; however, there are areas of sparse vegetation and erosion along some of the side slopes and where vehicular and foot traffic are prevalent. At one time, a baseball diamond was located in the southern portion of Area A.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Ionia City Landfill operated from the mid- to late-1950s until 1968 or 1969. During this time, industrial, commercial and municipal wastes were disposed at the Site, including drummed liquids and solids from industrial sources. Drums of ignitable liquid wastes were reportedly burned until late 1965. In October 1965, an explosion occurred during the burning of wastes resulting in the death of a waste hauler. In 1966, the Michigan Department of Natural Resources (MDNR) classified the Site as an open dump.

1.a

Reproduced from
best available copy.

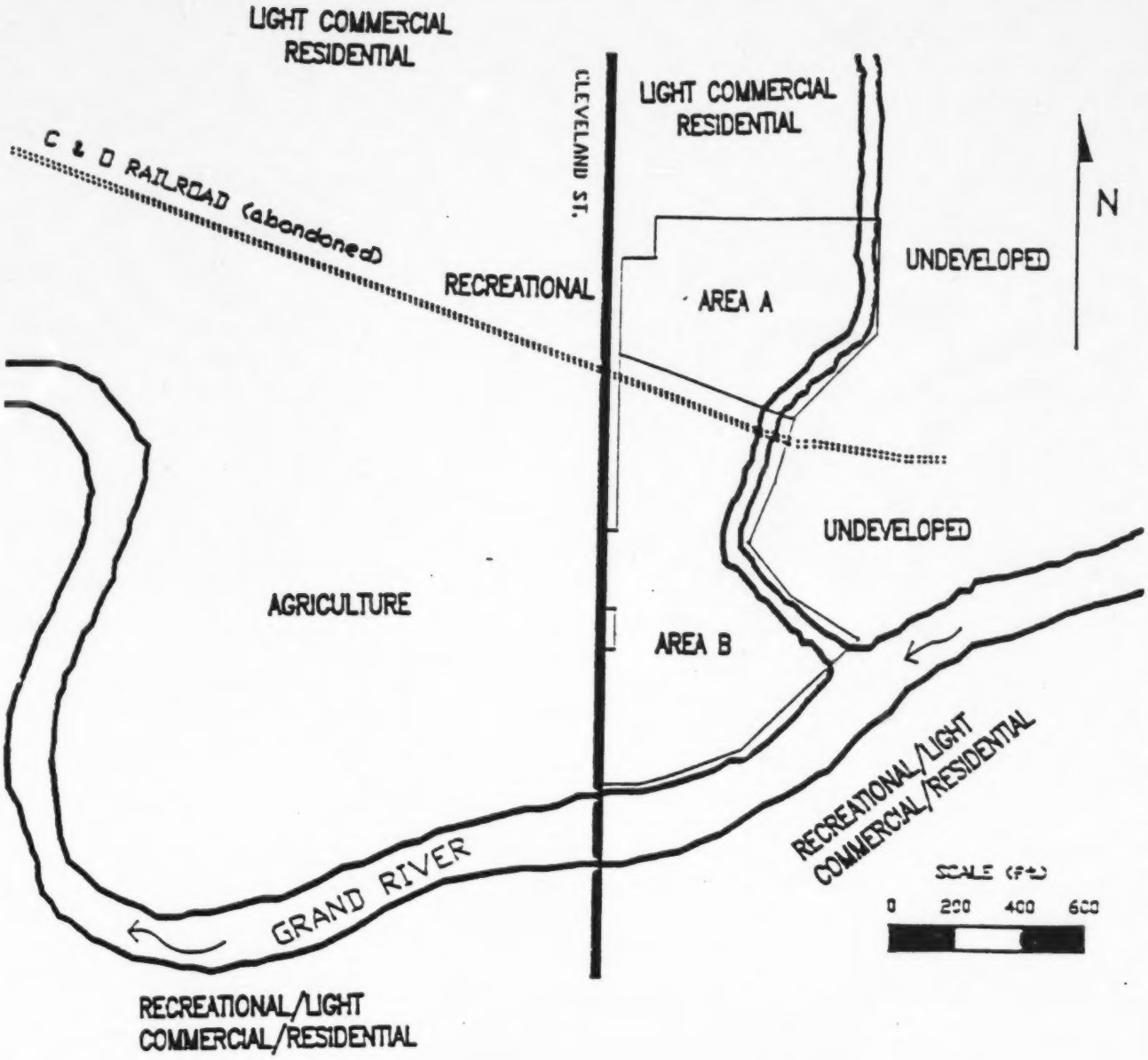


ROLLINS ENVIRONMENTAL SERVICES (FS) INC.

IONIA CITY LANDFILL

FIGURE 1

AREA MAP



ROLLINS ENVIRONMENTAL SERVICES (FS) INC.
IONIA CITY LANDFILL

FIGURE 2
SITE MAP

In August 1967, the City of Ionia applied to the MDNR for an operating license which may never have been issued.

The investigation of the Site was triggered by an anonymous phone call received by MDNR's Pollution Emergency Alerting System in early 1981. This call led to a March 1981 inspection by the MDNR during which exposed drums were observed and sampled. Analysis of samples indicated drum contents representative of paint wastes, thinners and industrial solvents, including ethylbenzene, trichloroethylene, methylene chloride, styrene, toluene and xylene. Elevated levels of lead, chromium, zinc and iron were also detected.

In July 1981, MDNR's Water Quality Staff installed three shallow observation wells in Area A. Analytical results of samples collected from two of the wells (the third well was damaged shortly after installation) detected 1,1-dichloroethane, 1,2-dichloroethylene, methyl chloroform, toluene, trichloroethylene, and elevated levels of cadmium, chromium, copper, lead, zinc and iron.

U.S. EPA's Field Investigation Team conducted a site inspection in May 1982, during which water and sediment samples were collected from the tributary to the Grand River. Results indicated the presence of 1,1-dichloroethane, dichloroethylene, and vinyl chloride at downgradient locations. The surface water data, in conjunction with previously collected groundwater data, was the basis for preparing a Hazard Ranking System (HRS) score for the Site in 1982, with subsequent placement on the National Priorities List (NPL) in December 1982.

A Site inspection conducted by U.S. EPA's Technical Assistance Team (TAT) in September 1983, noted a number of exposed drums in Area A. The TAT recommendations included restricting site access, posting of warning signs and a future inspection the following Spring to check for and, if present, sample leachate seeps. U.S. EPA's Environmental Services Division and Emergency Response Team conducted a follow-up inspection in May 1984. At this time the Site was recommended for immediate removal action. In June 1984, the City of Ionia was issued an administrative order requiring the City to secure the Site by constructing a fence around Area A, remove and dispose of exposed drums, cover depressed areas and stabilize areas where erosion had occurred. This work was completed in early 1985.

On April 12, 1985, U.S. EPA issued general notice letters to four potentially responsible parties (PRPs) informing them of their potential liability with respect to response actions, past or planned, taken at the Site, and asking them to undertake a Remedial Investigation and Feasibility Study (RI/FS). The four parties noticed included A.O. Smith Corporation, Mitchell Corporation, the General Tire and Rubber Company and the City of Ionia. Negotiations with the PRPs concluded in December 1985 when two PRPs, A.O. Smith Corporation and Mitchell Corporation, entered into an agreement with U.S. EPA to conduct the RI/FS at the Site. An Administrative Order by Consent became effective upon its signature by the Regional Administrator on January 29, 1986. The PRPs retained Rollins Environmental Services (Rollins) from Houston, Texas as their environmental

consulting firm. Project personnel have recently relocated to The Earth Technology Corporation in Houston and are fulfilling their project obligations under a subcontract with Rollins. Following Work Plan approval, RI field work began in March 1987 and was completed in May 1988.

General Notice Letters were mailed to 18 PRPs on August 29, 1989 informing them of future remedial actions planned at the Site and their potential liabilities with respect to the Site. Formal negotiations for PRP implementation of the source control remedial design/remedial action (RD/RA) will commence shortly after signature of this ROD with the issuance of Special Notice Letters. It is anticipated that the State of Michigan will play an active role in RD/RA negotiations.

III. COMMUNITY RELATIONS ACTIVITIES

The MDNR has been the lead agency in the implementation of community relations activities at the Site through a multi-site cooperative agreement with the U.S. EPA. U.S. EPA has functioned as a support agency when requested by MDNR. MDNR has prepared and distributed progress reports at milestones throughout the RI/FS process to inform the general public and interested parties of remedial activities at the Site. Progress reports have generally coincided with the initiation of the various RI field tasks. MDNR coordinated and monitored the RI/FS kick-off meeting in July 1986, attended by approximately thirty people.

Two information repositories have been established in the City of Ionia which contain the administrative record for the Site. The administrative record consists of all documents, data summaries, progress reports, correspondence, public comments and other relevant information used in developing and selecting remedial action alternative(s) for the Site. These documents are available at the Ionia City Hall, 114 North Kidd Street and the Fowler Memorial Library, 126 East Main Street in Ionia.

The FS report and Proposed Plan were made available for public comment during the period of August 25, 1989 through September 18, 1989. A public meeting was held on August 31, 1989 at the Ionia City Hall to answer questions and accept comments from interested parties and individuals on the FS report and Proposed Plan. There were no written comments received during the public comment period. Two oral comments were received during the public meeting and are addressed under Community Acceptance in Section VIII of this document.

There has been limited community interest in the Site throughout the RI/FS process. Approximately 25 people attended the August 31, 1989 public meeting, of which only three or four were residents. Other attendees included officials from the City of Ionia, MDNR and U.S. EPA personnel, attorneys for the participating PRPs, representatives of recently noticed PRPs and a reporter from the local newspaper. As the owner of the Site, the City of Ionia has maintained interest for reasons of potential future liabilities. Conversations with City officials suggests a general attitude of "It's about time some clean up action is planned for the Site."

IV. ROLE AND SCOPE OF RESPONSE ACTION

The exposure pathways and associated risks from hazardous substances present at the Site are discussed in detail in the Endangerment Assessment (EA) and summarized in the RI and FS reports. Based on the findings of the RI and the evaluation of potential exposure pathways and associated risks, two exposure routes, groundwater and subsurface wastes or point source, were identified as requiring the formulation and evaluation of potential remedial alternatives. The point source is approximately 1/4 acre in size with a total waste volume of approximately 5000 cubic yards consisting of buried drums, associated wastes and contaminated soils in the north-central portion of Area A of the Site. The groundwater pathway consists of the contaminant plume delineated in the unconfined shallow aquifer.

The FS report identified the following remedial objectives for the Site.

Surface Water
Prevent deterioration of existing surface water quality during and following remediation.

Sediments
Prevent deterioration of existing sediment quality during and following remediation.

Surface Soil
Prevent the deterioration of existing surface soil quality during and following remediation.

Subsurface Soil and Wastes (Point Source)
Prevent the potential migration of contaminants to groundwater during and following remediation.

Groundwater
Prevent the migration of unsafe levels of contaminants to drinking water and/or public use sources.

Air
Prevent deterioration of existing air quality during remediation.

Subsurface
Prevent the potential migration of contaminants to subsurface soils and groundwater by reducing toxicity.

Unlike the Proposed Plan, this response action is limited to an operable unit for the point source area. A final decision on groundwater is deferred until the completion of the groundwater monitoring program. The remedial action selected for the point source area provides for complete remediation by permanently reducing or eliminating the toxicity, mobility and volume of hazardous substances at the point source. In the event the selected alternative does not provide the necessary level of remediation, as documented by the pilot test, U.S. EPA intends to implement the contingency remedial alternative, partial excavation with on-site

incineration, after appropriate Agency guidance has been followed. The contingency remedy also serves as a complete source remedy by permanently eliminating the toxicity, mobility and volume of hazardous substances at the Site by full excavation of the point source; however, depending on the characteristics of residual ash, it may have to be handled and disposed of as hazardous.

Groundwater monitoring will be conducted to assure that point source remediation is complete, monitor the migration of residual contamination in groundwater and verify the assumption that no further source areas exist within the landfill. A decision on further groundwater action is deferred until completion of the groundwater monitoring program.

V. SUMMARY OF SITE CHARACTERISTICS

RI field activities were conducted by Rollins between March 1987 and May 1988 to characterize the nature and extent of contamination at and near the Site. Site investigation activities included the following.

* Residential wells within close proximity of the Site were sampled to determine the impact, if any, of the Site on drinking water supply wells.

* A magnetometer survey was conducted to locate potential deposits of buried drums within the landfill mass. This was followed by field verification and sampling to determine physical characteristics, chemical constituents, and metes and bounds of any buried drums and wastes. Soil samples were collected to determine the degree and extent of soil contamination associated with any buried drum deposits.

* Shallow soils adjacent to the Site boundaries were sampled to determine any off-site contamination attributable to surface water runoff, leaching from landfill side slopes and possible waste deposition as a result of past explosions or fires at the Site.

* Surface water and sediment samples were collected from the east tributary and Grand River to assess the impact of the Site on surface water bodies and potential downgradient receptors.

* Groundwater monitoring wells were installed and sampled to characterize groundwater conditions and hydraulic properties of aquifer units, determine lateral and vertical extent of groundwater contamination, identify contaminants of concern, and evaluate the potential for future migration of contaminants into the soil and groundwater at and near the Site.

* Multiple groundwater sampling events were conducted to verify the adequacy of the groundwater monitoring network, monitor the migration of contamination and assess seasonal variations in contaminant concentrations.

* Soil samples were collected from the landfill cap for laboratory determination of physical properties to assess the potential for surface water infiltration into the landfill.

* Air monitoring was conducted to determine the potential for off-site migration of volatile organics under ambient conditions.

The major findings of the RI are summarized below.

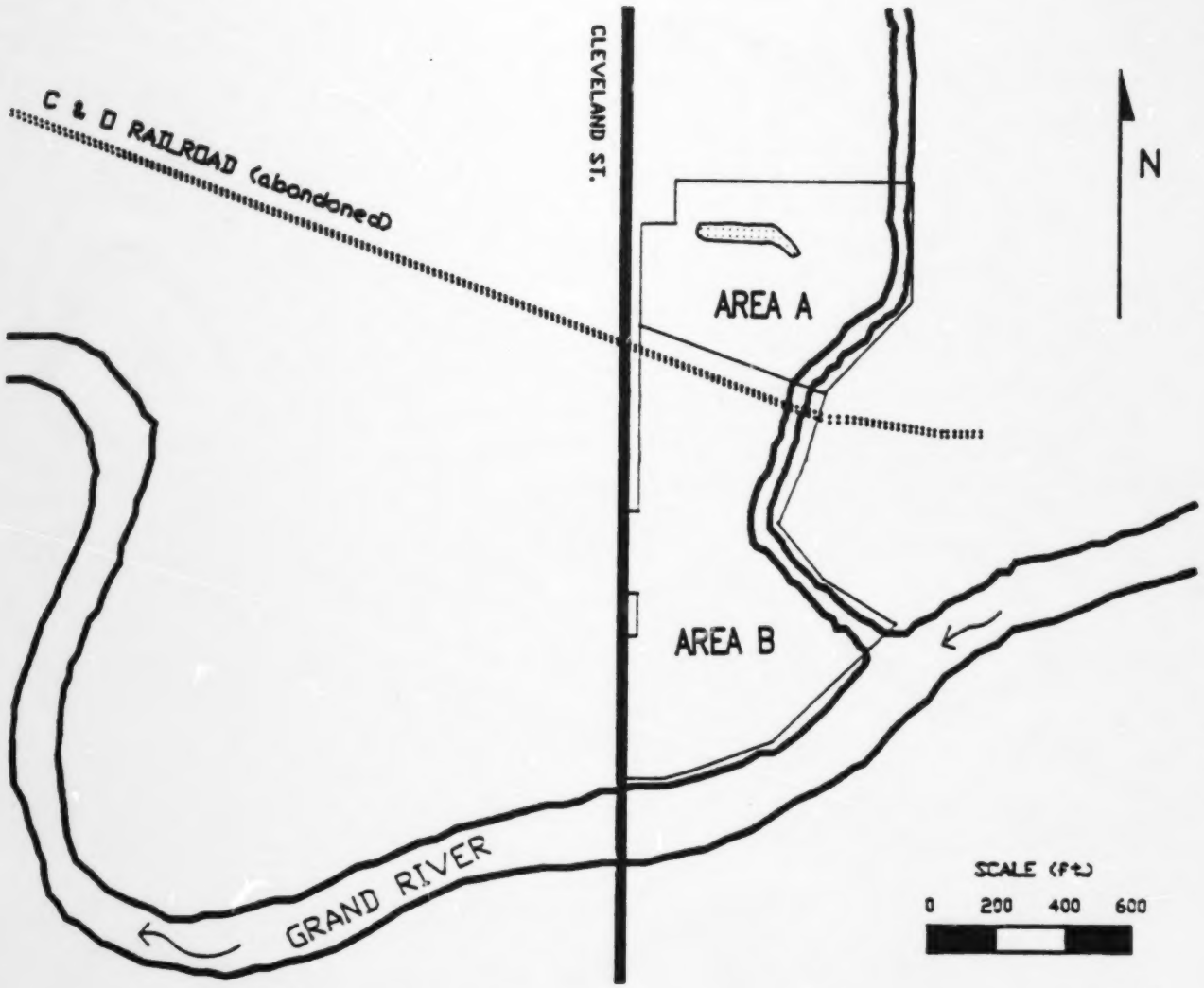
* Approximately 5000 cubic yards of drummed materials, associated wastes and contaminated soils were discovered in the north central portion of Area A (Figures 3 and 4). This has been defined as the point source area. The drums contained paint residues, various organic materials and solvents. The majority of the drums observed during trenching activities were not intact, and badly deteriorated. Of the intact drums encountered, some contained liquids. Table 1 presents organic and inorganic results from samples collected during field verification of buried drum locations in Area A.

* Borings and monitoring well installations (Figure 5) have identified two definable shallow water bearing zones beneath the landfill; an upper sand and gravel aquifer (A-1) and a deeper sand aquifer (A-2). The A-1 aquifer is composed of a silty, fine-grained sand to well-graded gravel and ranges in thickness from 9 to 24 feet. Beneath the A-1 aquifer is a confining unit (CL-1) of unknown areal extent comprised of a sandy, gravelly clay. CL-1 ranges in thickness from 9 to 17 feet. The lower A-2 aquifer is composed of fine sands to sandy gravel with minor clay seams and ranges in thickness from 15 to 61 feet. The basal CL-2 unit is of unknown thickness and consists of high-plasticity clays to clayey silts. Refer to Figures 6 and 7 for geologic cross sections depicting the aquifers and confining units.

* The A-1 aquifer is semi-confined with water levels appearing at depths of 1 to 13 feet below ground surface. The general flow direction of the A-1 aquifer is northeast to southwest toward the Grand River.

* The A-2 aquifer is confined with a water level above that of the A-1 aquifer, indicating that an upward flow component exists between the two water-bearing zones. As in the A-1 aquifer, the general groundwater flow direction in the A-2 aquifer is northeast to southwest.

* Groundwater analyses for Hazardous Substance List (HSL) compounds from three sampling events; March 1989, September 1987, and May 1988; have confirmed the presence of a contamination plume within

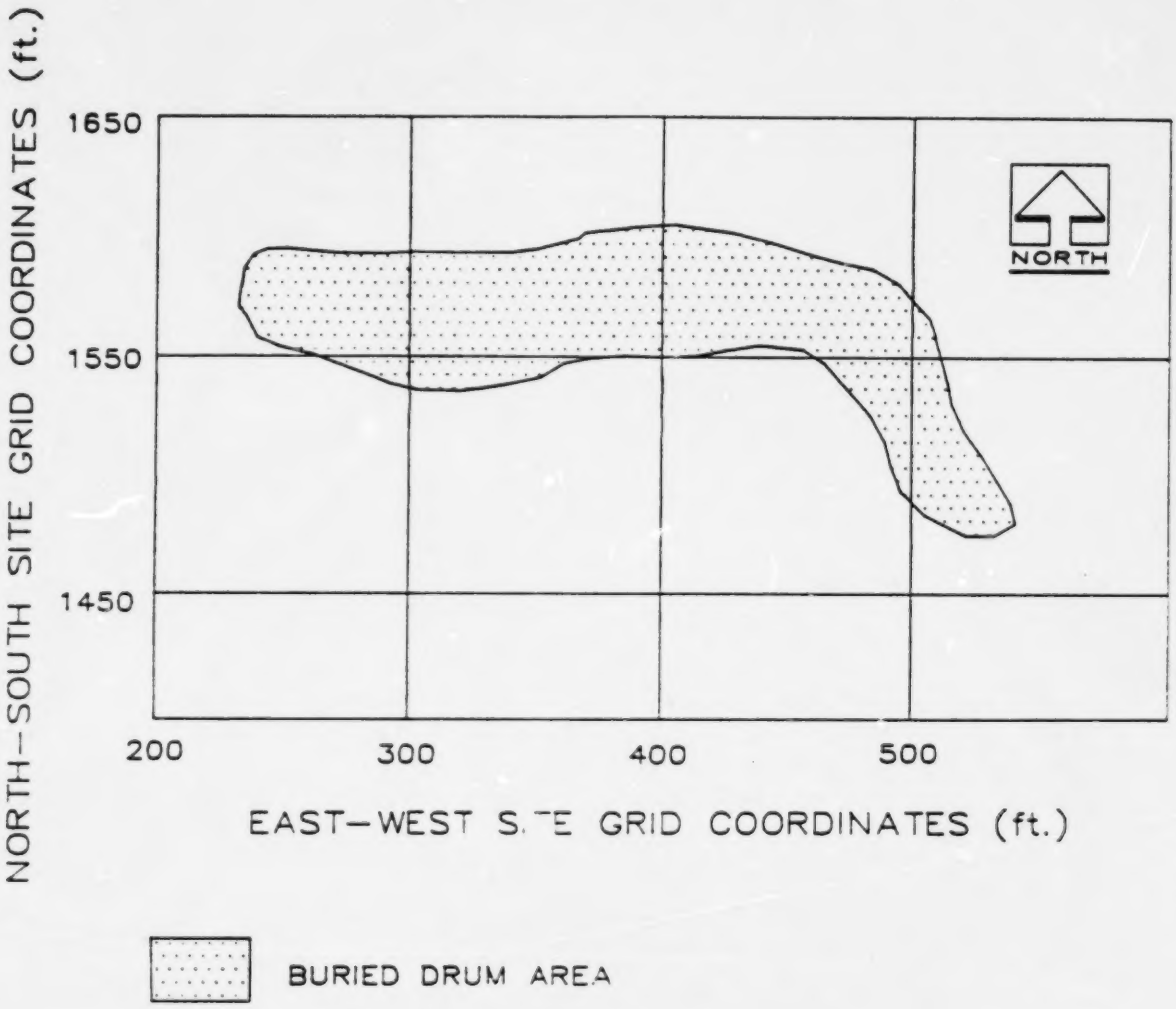


- BURIED DRUM AREA

ROLLINS ENVIRONMENTAL SERVICES (FS) INC.
IONIA CITY LANDFILL

FIGURE 3

BURIED DRUM LOCATION



ROLLINS ENVIRONMENTAL SERVICES (FS), INC.
TECHNOLOGY & ASSESSMENT DIVISION

IONIA CITY LANDFILL

FIGURE 4

BURIED DRUM AREA

TABLE 1
ORGANIC ANALYTICAL SUMMARY
AREA A - TRENCH SAMPLING
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/Kg (ppb)										FIELD BLANK 000-01	DETECTION LIMIT (2)
	045-01	045-03	045-05 DRUM	046-01	046-02	046-03	046-06 DRUM	047-01	047-02	048-01		
METHYLENE CHLORIDE	*29,000.0	*790.0	*18,000.0	*2,220,000.0	*88,000.0	*16.0	*110,000.0	*1,100	*140.0	*28.0	*73.0	5.0
ACETONE	*140,000.0	9,200.0	--	--	--	--	--	--	--	--	--	10.0
1,1,1 TRICHLOROETHANE	--	940.0	6,000.0	--	--	130.0	640,000.0	--	--	--	--	5.0
TRICHLOROETHENE	--	--	2,000.0	--	--	*34.0	--	--	--	--	--	5.0
TETRACHLOROETHENE	--	--	--	--	--	13.0	--	--	--	--	--	5.0
TOLUENE	9,800.0	2,400.0	*2,300.0	--	--	13.0	460,000.0	--	--	--	--	5.0
ETHYLBENZENE	--	790.0	14,000.0	--	--	--	110,000.0	--	--	--	--	5.0
STYRENE	*33,000.0	--	*9,600.0	*4,600,000.0	*2,200,000.0	--	*1,900,000.0	*2,100	--	--	--	5.0
TOTAL XYLENES	--	--	--	--	--	--	*580,000.0	--	--	--	--	5.0
PHENANTHRENE	--	--	--	--	--	--	--	--	--	1,600.0	--	330.0
FLUORANTHENE	--	--	--	--	--	--	--	--	--	1,400.0	--	330.0
PYRENE	--	--	--	--	--	--	--	--	--	1,100.0	--	330.0
BUTYLBENZYLPHTHALATE	2,400,000.0	10,000.0	--	--	--	--	12,000,000.0	--	--	--	--	330.0
BENZO(A)ANTHRACENE	--	--	--	--	--	--	--	--	--	580.0	--	330.0
BIS(2-ETHYLHEXYL) PHTHALATE	130,000.0	--	--	--	--	--	--	--	--	--	--	330.0
CHRYSENE	--	--	--	--	--	--	--	--	--	620.0	--	330.0
BENZO(K)FLUORANTHENE	--	--	--	--	--	--	--	--	--	510.0	--	330.0
BENZO(A)PYRENE	--	--	--	--	--	--	--	--	--	480.0	--	330.0
pH	7.6	7.9	8.2	8.15	7.9	7.9	7.3	7.8	7.4	7.7		N/A
PERCENT SOLIDS	83.0	84.0	57.0	90.0	51.0	85.0	72.0	67.0	58.0	72.0		N/A

(1) - ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-OS-XXX-XX OR ICL-DR-XXX-XX.
(2) - LISTED DETECTION LIMITS BASED ON 100% SOLIDS, "LOW LEVEL" SOIL MATRIX.
* - COMPOUNDS DETECTED IN A LABORATORY QC BLANK.
N/A - NOT APPLICABLE.

6.C

TABLE 1 CONTINUED
AREA-A TRENCH SAMPLING
INORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

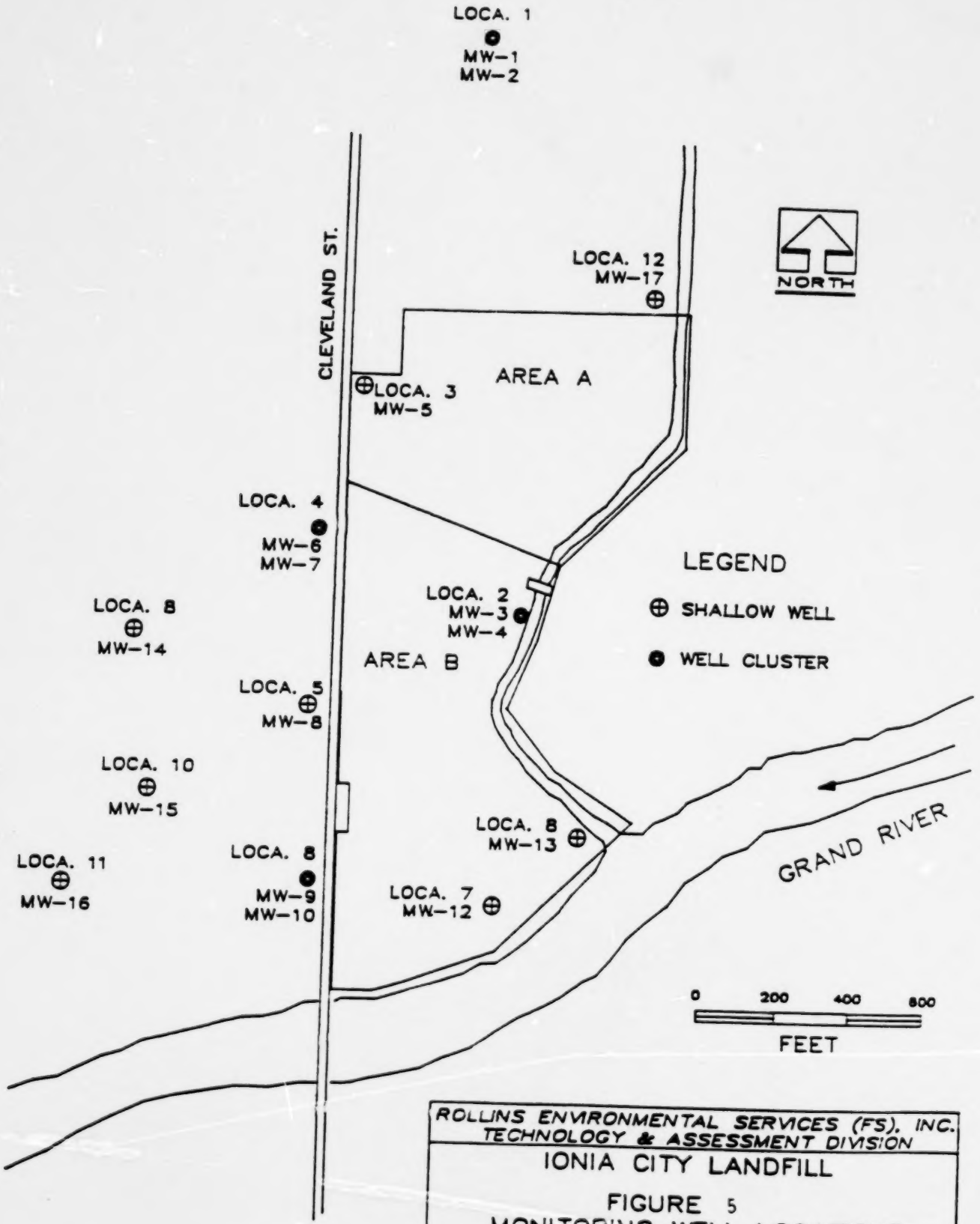
PARAMETER	SAMPLE ID NUMBER (1) CONCENTRATION AS mg/Kg (ppm)										DETECTION LIMIT (2)
	045-01	045-03	045-05 DRUM	046-01	046-02	046-03	046-06 DRUM	047-01	047-02	048-01	
ALUMINUM	6140.0	10100.0	7820.0	669.0	2360.0	12700.0	9210.0	10900.0	24200.0	10500.0	20.0
ANTIMONY	--	--	--	--	--	--	--	--	--	--	6.0
ARSENIC	6.5	9.3	10.0	3.8	3.9	12.0	7.2	15.0	48.0	15.0	1.0
BARIUM	226.0	209.0	145.0	220.0	118.0	54.0	8870.0	470.0	370.0	175.0	20.0
BERYLLIUM	--	--	--	--	--	0.6	--	1.4	1.1	--	0.5
CADMIUM	--	--	--	--	--	--	--	--	--	--	0.50
CALCIUM	56200.0	69200.0	52700.0	9230.0	12800.0	86400.0	6670.0	42000.0	6980.0	15200.0	500.0
CHROMIUM	29.0	32.0	108.0	54.0	14.0	21.0	2850.0	19.0	35.0	23.0	1.0
COBALT	--	7.6	18.0	--	--	8.5	--	--	16.0	7.8	5.0
COPPER	27.0	18.0	31.0	4.4	17.0	14.0	236.0	128.0	11.0	65.0	2.5
IRON	19200.0	17900.0	40500.0	6650.0	7800.0	22700.0	6050.0	22500.0	68800.0	27500.0	10.0
LEAD	84.0	65.0	237.0	36.0	6.4	7.1	10100.0	478.0	14.0	83.0	0.5
MAGNESIUM	18300.0	25700.0	36900.0	1850.0	3540.0	26800.0	--	7860.0	5810.0	4410.0	500.0
MANGANESE	238.0	318.0	365.0	64.0	98.0	383.0	23.0	376.0	589.0	646.0	1.5
MERCURY	0.31	--	0.37	0.19	--	--	1.0	1.5	--	0.16	0.02
NICKEL	18.0	22.0	262.0	4.7	--	25.0	152.0	20.0	41.0	20.0	4.0
POTASSIUM	975.0	1700.0	1300.0	--	--	1750.0	--	761.0	2100.0	1230.0	500.0
SELENIUM	--	--	--	--	--	--	--	--	--	--	0.5
SILVER	--	--	--	--	--	--	--	--	--	--	1.0
SODIUM	--	--	--	--	--	--	--	--	--	--	500.0
THALLIUM	--	--	--	--	--	--	--	--	--	--	1.0
VANADIUM	17.0	22.0	21.0	--	--	30.0	--	23.0	61.0	27.0	5.0
ZINC	96.0	128.0	99.0	44.0	32.0	39.0	1200.0	1000.0	71.0	334.0	2.0
pH	7.6	7.9	8.2	8.15	7.9	7.9	7.3	7.8	7.9	7.7	N/A
PERCENT SOLIDS	83.0	84.0	57.0	90.0	51.0	85.0	72.0	67.0	58.0	72.0	N/A

(1) - ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-OS-XXX-XX

(2) - LISTED DETECTION LIMITS BASED ON 100% SOLIDS; "LOW LEVEL" SOIL MATRIX.

N/A - NOT APPLICABLE

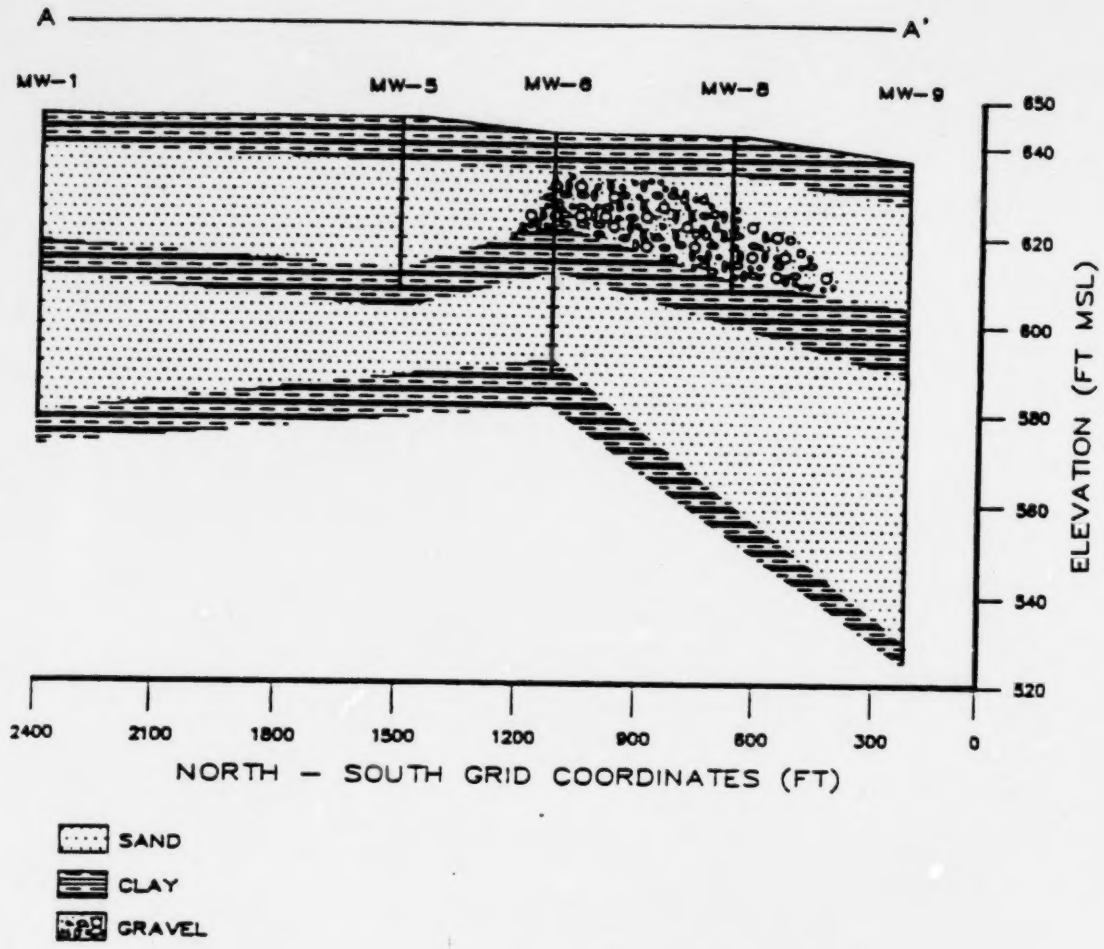
6.e



ROLLINS ENVIRONMENTAL SERVICES (FS), INC.
TECHNOLOGY & ASSESSMENT DIVISION

IONIA CITY LANDFILL

FIGURE 5
MONITORING WELL LOCATIONS

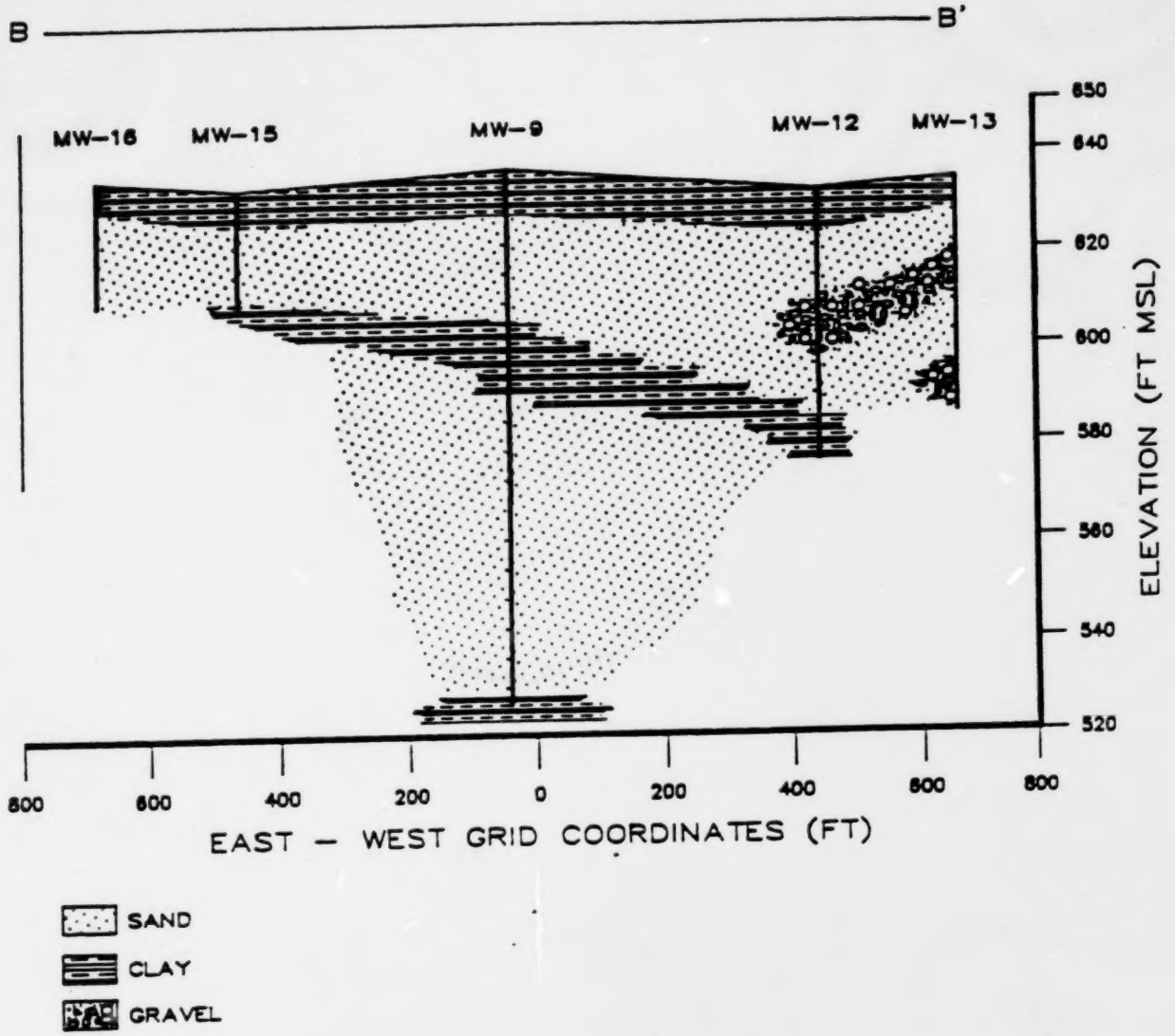


ROLLINS ENVIRONMENTAL SERVICES (FS), INC.
TECHNOLOGY & ASSESSMENT DIVISION

IONIA CITY LANDFILL

FIGURE 6

GEOLOGIC CROSS SECTION A–A'



ROLLINS ENVIRONMENTAL SERVICES (FS), INC.
TECHNOLOGY & ASSESSMENT DIVISION

IONIA CITY LANDFILL
FIGURE 7
GEOLOGIC CROSS SECTION B - B'

the shallow A-1 aquifer containing organic compounds (vinyl chloride, 1,1 dichloroethane, and trans-1,2-dichloroethene) and elevated inorganics (cadmium, chromium and selenium). Vinyl chloride was detected at concentrations ranging to 89 parts per billion (ppb), above the Federal Maximum Contaminant Level (MCL) of 2 ppb. The contaminant plume is discharging to the Grand River south of the Site and also extends beneath agricultural land west of the Site (Figure 8). Table 2 presents organic and inorganic results from A-1 aquifer sampling events 1,2 and 3.

* No organic compounds attributed to the Site were detected in the A-2 aquifer for any of the three sampling events. Inorganic analysis indicated slightly elevated concentrations of cadmium, chromium, iron and manganese; however levels are below applicable primary and secondary drinking water standards.

* Sampling and analysis of surface waters from the east tributary and the Grand River for HSL compounds indicated the presence of elevated levels of cadmium in downgradient Grand River samples. Exposed fill material and debris along the eastern and southern boundaries of Area B is the suspected source of the cadmium. Organic results from surface water analysis did not indicate any contaminants attributable to the Site. Refer to Figure 9 for surface water sampling locations and Table 3 for inorganic analytical results.

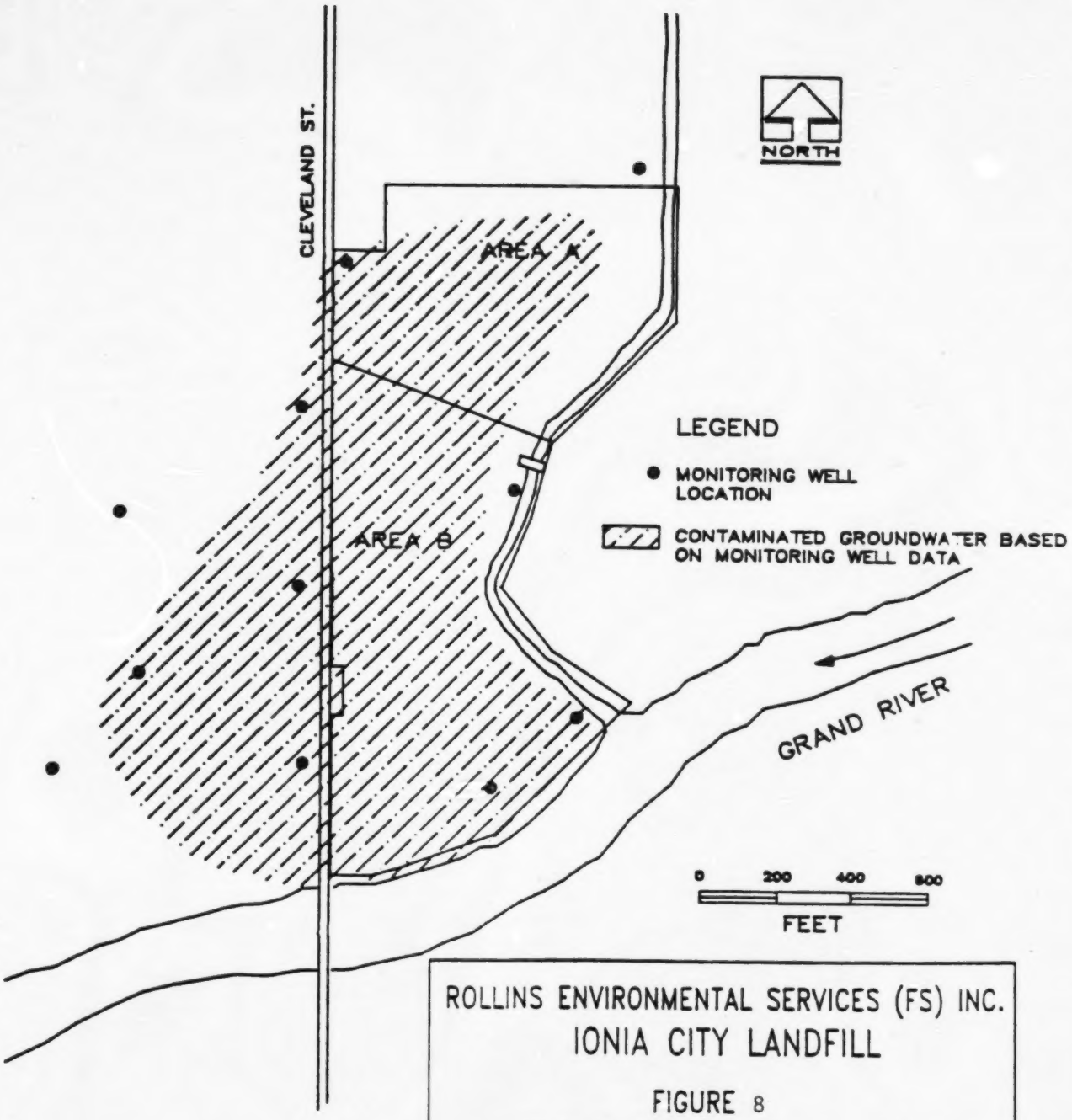
* Sampling and analysis of sediments from the east tributary and Grand River for HSL compounds indicated higher concentrations of organics and inorganics in east tributary samples when compared to upgradient samples from the Grand River. However, upgradient samples from the east tributary generally contained the highest number and concentrations of contaminants. Figure 9 illustrates sediment sampling locations and Table 4 presents inorganic and organic analytical results.

* Ambient air sampling did not detect any organic compounds at concentrations above Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits or MDNR criteria. Additionally, there were no significant differences between the upwind and downwind analytical results with respect to the compounds detected and their concentrations.

* The Endangerment Assessment indicated that the ingestion of contaminated shallow groundwater downgradient south of the Site presents an unacceptable noncarcinogenic and carcinogenic risk, primarily due to the presence of vinyl chloride above Federal MCLs. The risks associated with exposure to other potential migration pathways were found to be within acceptable levels.

* Sampling of residential wells within the area did not indicate any contaminants attributable to the Site. Furthermore, there are no private wells located downgradient of the Site. Further

7.a



ROLLINS ENVIRONMENTAL SERVICES (FS) INC.
IONIA CITY LANDFILL

FIGURE 8
SHALLOW AQUIFER PLUME LIMITS

TABLE 2
MONITORING WELLS - FIRST SAMPLING EVENT - A1 AQUIFER
ORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/L (ppb)								DETECTION LIMIT (2)
	027-01	029-01	030-01	032-01	033-01	035-01	037-01	038-01	
WELL NUMBER	MW-2	MW-4	MW-5	MW-7	MW-8	MW-10	MW-12	MW-13	
VINYL CHLORIDE	--	--	--	86.0	--	--	--	52.0	10.0
ACETONE	*21.0	*16.0	--	--	*12.0	*10.0	*29.0	--	10.0
1,1 DICHLOROETHANE	--	--	--	24.0	--	7.0	--	--	5.0
TRANS-1,2 DICHLOROETHENE	--	--	--	--	12.0	--	5.0	15.0	5.0
BENZENE	--	--	--	6.0	--	--	--	--	5.0
N-NITROSODIPHENYLAMINE	--	--	--	*17.0	*11.0	--	*11.0	--	10.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-MW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMIT FOR "LOW LEVEL" WATER MATRIX.

* - COMPOUND DETECTED IN THE Q.C. BLANK.

TABLE 2 CONTINUED
MONITORING WELLS - SECOND SAMPLING EVENT - A1 AQUIFER
ORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/l (ppb)										DETECTION LIMIT (2)
	027-02	029-02	030-02	030-03	032-02	033-02	035-02	037-02	038-02	038-03	
WELL NUMBER	MW-2	MW-4	MW-5	MW-5	MW-7	MW-8	MW-10	MW-12	MW-13	MW-13	
VINYL CHLORIDE	--	--	--	69.0	--	--	--	--	41.0	39.0	10.0
CARBON DISULFIDE	--	--	--	--	--	10.0	--	--	--	--	5.0
1,1 DICHLOROETHANE	--	--	--	26.0	--	-	8.0	--	--	--	5.0
TRANS-1,2-DICHLORETHENE	--	--	--	--	--	23.0	--	--	17.0	18.0	5.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-MW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMIT FOR "LOW LEVEL" WATER MATRIX.

* - COMPOUND DETECTED IN A LABORATORY Q.C. BLANK.

7.C

TABLE 2 CONTINUED
MONITORING WELLS - THIRD SAMPLING EVENT - A1 AQUIFER
ORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/l (ppb)													DETECTION LIMIT (2)
	027-03	029-03	030-04	032-03	033-03	035-03	037-03	038-04	038-05	066-01	067-01	068-01	068-02	069-01	
WELL NUMBER	MW-2	MW-4	MW-5	MW-7	MW-8	MW-10	MW-12	MW-13	MW-13	MW-14	MW-15	MW-16	MW-16	MW-17	
VINYL CHLORIDE	..	..	..	56.0	..	..	..	61.0	68.0	..	47.0	..	..	..	10.0
1,1-DICHLOROETHANE	..	..	..	26.0	..	6.0	..	..	..	..	..	..	..	..	5.0
TRANS-1,2 DICHLOROETHENE	..	..	..	..	11.0	..	..	28.0	31.0	..	17.0	..	..	..	5.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-MW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMIT FOR "LOW LEVEL" WATER MATRIX.

TABLE 2 CONTINUED
MONITORING WELLS - FIRST SAMPLING EVENT - A1 AQUIFER
INORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) ug/l (ppb) 027-01	029-01	030-01	032-01	033-01	035-01	037-01	038-01	DETECTION LIMIT (2)
WELL NUMBER	MW-2	MW-4	MW-5	MW-7	MW-8	MW-10	MW-12	MW-13	
ALUMINUM	--	--	--	--	--	--	--	--	200.0
ANTIMONY	--	--	--	--	--	--	--	--	60.0
ARSENIC	--	--	--	--	--	--	--	--	10.0
BARIUM	--	--	--	--	--	218.0	--	--	211.0
BERYLLIUM	--	--	--	--	--	--	--	--	5.0
CADMIUM	--	8.0	10.0	8.0	9.0	10.0	--	22.0	5.0
CALCIUM	70000.0	122000.0	104000.0	170000.0	119000.0	127000.0	111000.0	92800.0	5000.0
CHROMIUM	--	--	--	--	--	--	--	--	10.0
COBALT	--	--	--	--	--	--	--	--	50.0
COPPER	--	--	--	--	--	--	--	--	255.0
IRON	--	--	--	--	--	482.0	304.0	--	100.0
LEAD	--	--	--	--	--	--	--	--	5.0
MAGNESIUM	39600.0	43200.0	42400.0	76300.0	71600.0	68800.0	36800.0	40600.0	5000.0
MANGANESE	--	199.0	183.0	523.0	580.0	817.0	658.0	225.0	15.0
MERCURY	--	--	--	--	--	--	--	--	0.2
NICKEL	--	--	--	--	--	--	--	--	40.0
POTASSIUM	--	7580.0	33200.0	17700.0	20800.0	19300.0	--	--	5000.0
SELENIUM	--	--	--	--	--	--	--	--	5.0
SILVER	--	--	--	--	--	--	--	--	10.0
SODIUM	22700.0	58300.0	28900.0	79500.0	59200.0	88700.0	83000.0	49600.0	5000.0
THALLIUM	--	--	--	--	--	--	--	--	10.0
VANADIUM	--	--	--	--	--	--	--	--	50.0
ZINC	--	--	--	--	--	--	--	--	20.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-MW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMIT FOR "LOW LEVEL" WATER MATRIX.

TABLE 2 CONTINUED
MONITORING WELLS - SECOND SAMPLING EVENT - A1 AQUIFER
INORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/l (ppb)										DETECTION LIMIT (2)
	027-02	029-02	030-02	030-03	032-02	033-02	035-02	037-02	038-02	038-03	
WELL NUMBER	MW-2	MW-4	MW-5	MW-5	MW-7	MW-8	MW-10	MW-12	MW-13	MW-13	
ALUMINUM	--	--	--	227.0	--	--	214.0	--	--	--	200.0
ANTIMONY	--	--	--	--	--	--	--	--	--	--	60.0
ARSENIC	20.0	--	--	--	--	--	--	--	--	--	10.0
BARIUM	--	--	--	--	--	206.0	--	--	--	--	200.0
BERYLLIUM	--	--	--	--	--	--	--	--	--	--	5.0
CADMIUM	5.5	7.0	--	9.1	5.7	8.4	9.5	5.3	6.7	5.8	5.0
CALCIUM	83000.0	121000.0	150000.0	149000.0	92400.0	124000.0	163000.0	106000.0	93400.0	92600.0	5000.0
CHROMIUM	--	186.0	87.0	12.0	--	12.0	14.0	--	--	--	10.0
COBALT	--	--	--	--	--	--	--	--	--	--	50.0
COPPER	--	--	52.0	--	--	--	--	--	--	--	255.0
IRON	312.0	4610.0	317.0	10000.0	1000.0	2040.0	7830.0	2140.0	1310.0	1250.0	100.0
LEAD	--	--	--	--	--	--	--	--	3.6	--	5.0
MAGNESIUM	31800.0	34500.0	34000.0	52100.0	29500.0	66800.0	49000.0	29500.0	31600.0	31300.0	5000.0
MANGANESE	96.0	111.0	71.0	490.0	32.0	432.0	686.0	89.0	50.0	50.0	15.0
MERCURY	--	--	--	--	--	--	--	--	--	--	0.2
NICKEL	74.0	106.0	82.0	44.0	--	43.0	41.0	--	40.0	42.0	40.0
POTASSIUM	--	--	31100.0	16500.0	--	37800.0	21200.0	--	--	--	5000.0
SELENIUM	--	--	--	--	--	--	--	--	--	--	5.0
SILVER	11.0	10.0	10.0	13.0	--	--	12.0	--	10.0	11.0	10.0
SODIUM	16100.0	63600.0	20100.0	57300.0	155000.0	52800.0	59200.0	75100.0	37200.0	37000.0	5000.0
THALLIUM	--	--	--	--	--	--	--	--	--	--	10.0
VANADIUM	--	--	--	--	--	--	--	--	--	--	50.0
ZINC	20.0	--	39.0	--	--	--	--	--	--	--	20.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-MW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMIT FOR "LOW LEVEL" WATER MATRIX.

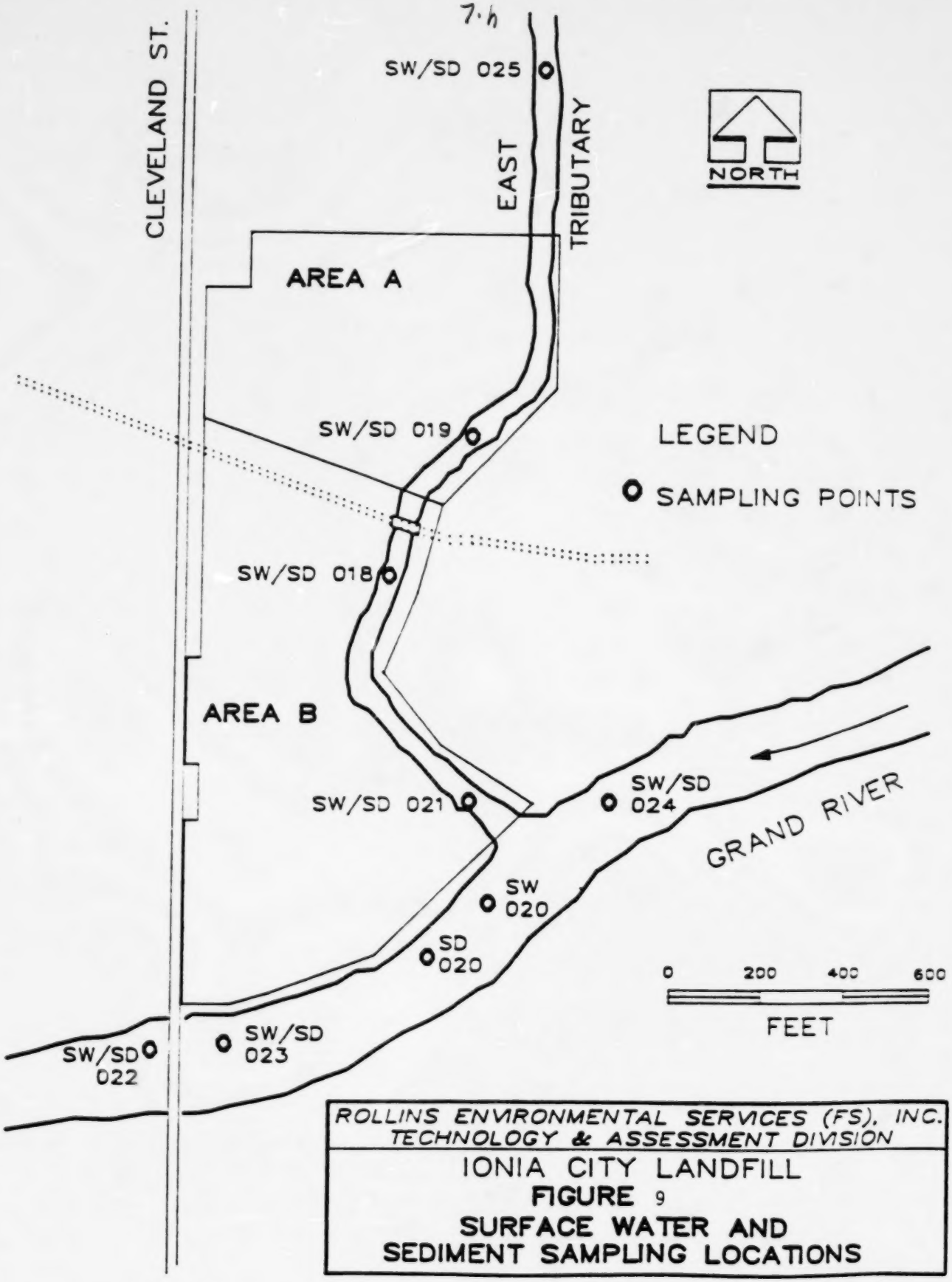
TABLE 2 CONTINUED

MONITORING WELLS - THIRD SAMPLING EVENT - A1 AQUIFER
INORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/l (ppb)													DETECTION LIMIT (2)
	027-03	029-03	030-04	032-03	033-03	035-03	037-03	038-04	038-05	066-01	067-01	068-01	068-02	069-01	
WELL NUMBER	MW-2	MW-4	MW-5	MW-5	MW-8	MW-10	MW-12	MW-13	MW-13	MW-14	MW-15	MW-16	MW-16	MW-17	
ALUMINUM	--	--	--	--	--	--	--	216.0	--	--	--	--	--	--	200.0
ANTIMONY	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60.0
ARSENIC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0
BARIUM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	200.0
BERYLLIUM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0
CADMIUM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0
CALCIUM	92300.0	137000.0	154000.0	165000.0	139000.0	18200.0	115000.0	109000.0	108000.0	150000.0	139000.0	121000.0	122000.0	135000.0	5000.0
CHROMIUM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0
COBALT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50.0
COPPER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25.0
IRON	292.0	4150.0	--	6590.0	1120.0	3780.0	2400.0	1070.0	829.0	464.0	903.0	--	30.0	--	100.0
LEAD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0
MAGNESIUM	36100.0	39400.0	34600.0	72500.0	83800.0	51400.0	31800.0	35200.0	35400.0	33700.0	34900.0	22500.0	22700.0	41000.0	5000.0
MANGANESE	127.0	140.0	142.0	515.0	516.0	897.0	71.0	85.0	79.0	303.0	337.0	118.0	120.0	235.0	15.0
MERCURY	--	--	--	--	--	--	--	--	--	--	--	3.2	--	--	0.2
NICKEL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40.0
POTASSIUM	--	--	29300.0	17600.0	31200.0	16400.0	--	--	--	--	--	--	--	--	5000.0
SELENIUM	--	--	12.0	--	--	--	--	--	--	--	--	--	--	5870.0	5.0
SILVER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0
SODIUM	19100.0	74700.0	21300.0	66800.0	65300.0	72300.0	79400.0	43600.0	44600.0	41800.0	44500.0	6820.0	6890.0	205000.0	5000.0
THALLIUM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0
VANADIUM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50.0
ZINC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS IN NOMENCLATURE ICL-MW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMIT FOR "LOW LEVEL" WATER MATRIX.



ROLLINS ENVIRONMENTAL SERVICES (FS), INC.
TECHNOLOGY & ASSESSMENT DIVISION

IONIA CITY LANDFILL

FIGURE 9

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

TABLE 3
SURFACE WATER SAMPLES
INORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE ID NUMBER (1) CONCENTRATION AS ug/l (ppb)									FIELD BLANK 000-01	DETECTION LIMIT (2)
	018-01	019-01	020-01	021-01	022-01	023-01	024-01	025-01	025-03		
ALUMINUM	--	--	--	--	--	--	--	--	--	--	200.0
ANTIMONY	--	--	--	--	--	--	--	--	--	--	60.0
ARSENIC	--	--	--	--	--	--	--	--	--	--	10.0
BARIUM	--	--	--	--	--	--	--	--	--	--	200.0
BERYLLIUM	--	--	--	--	--	--	--	--	--	--	5.0
CADMIUM	--	--	--	--	9.0	10.0	--	--	--	--	5.0
CALCIUM	124000.0	115000.0	92400.0	100000.0	83200.0	82500.0	75000.0	122000.0	104000.0	--	5000.0
CHROMIUM	--	--	--	--	--	--	--	--	--	--	10.0
COBALT	--	--	--	--	--	--	--	--	--	--	50.0
COPPER	--	--	--	--	--	--	--	--	--	--	25.0
IRON	--	--	--	--	--	--	--	--	--	--	100.0
LEAD	--	--	--	--	--	--	--	--	36.0	--	5.0
MAGNESIUM	--	--	24900.0	--	22000.0	21800.0	20800.0	--	--	--	5000.0
MANGANESE	--	--	--	--	--	--	--	--	--	--	15.0
MERCURY	--	--	--	--	--	--	--	--	--	--	0.2
NICKEL	--	--	--	--	--	--	--	--	--	--	40.0
POTASSIUM	--	--	--	--	--	--	--	5550.0	5900.0	--	5000.0
SELENIUM	--	--	--	--	--	--	--	--	--	--	5.0
SILVER	--	--	--	--	--	--	10.0	--	--	--	10.0
SODIUM	--	--	17400.0	--	14200.0	15800.0	13000.0	75100.0	80000.0	--	5000.0
THALLIUM	--	--	--	--	--	--	--	--	--	--	10.0
VANADIUM	--	--	--	--	--	--	--	--	--	--	50.0
ZINC	--	--	--	--	--	--	--	--	--	--	20.0

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-SW-XXX-XX

(2) - CONTACT REQUIRED DETECTION LIMITS BASED ON "LOW LEVEL" WATER MATRIX; INDIVIDUAL SAMPLE LIMITS ARE ADJUSTED ACCORDINGLY.

TABLE 4
ORGANIC ANALYTICAL SUMMARY
SEDIMENT SAMPLING
IONIA CITY LANDFILL

PARAMETER	SAMPLE IDENTIFICATION NUMBER (1) - CONCENTRATION AS ug/Kg (ppb)									FIELD BLANK 000-02	DETECTION LIMIT (2)
	018-02	019-02	020-02	021-02	022-02	023-02	024-02	025-02	025-04		
METHYLENE CHLORIDE	22.0	37.0	77.0	*14.0	--	--	*7.0	*8.0	--	*15.0	5.0
ACETONE	*35.0	*90.0	*120.0	--	*14.0	--	--	--	--	--	10.0
2-BUTANONE	*20.0	*21.0	*20.0	--	*20.0	*19.0	--	*17.0	--	*12.0	10.0
N-NITROSODIPHENYLAMINE	--	1100.0	--	--	--	--	--	--	--	--	330.0
PHENANATHRENE	--	--	--	--	--	--	--	1000.0	--	--	330.0
DI-N-BUTYLPHTHALATE	--	--	*640.0	*610.0	--	*600.0	--	*970.0	*1400.0	--	330.0
FLUORANTHENE	--	650.0	--	--	--	--	--	1500.0	2600.0	--	330.0
PYRENE	--	550.0	--	--	--	--	--	1200.0	2200.0	--	330.0
BENZO (a) ANTHRACENE	--	--	--	--	--	--	--	630.0	960.0	--	330.0
CHRYSENE	--	--	--	--	--	--	--	840.0	1400.0	--	330.0
BENZO (b) FLUORANTHENE	--	--	--	--	--	--	--	1200.0	1200.0	--	330.0
BENZO (k) FLUORANTHENE	--	--	--	--	--	--	--	--	1600.0	--	330.0
BENZO (a) PYRENE	--	--	--	--	--	--	--	730.0	1200.0	--	330.0
4,4'-DDE	--	--	--	--	--	--	--	40.0	--	--	16.0
4,4'-DDD	--	--	--	--	--	--	--	28.0	--	--	16.0
4,4'-DDT	27.0	25.0	--	--	--	--	--	24.0	--	--	16.0
pH	7.5	7.6	7.6	7.7	7.7	7.7	7.1	6.5	7.2		N/A
PERCENT MOISTURE	30.0	28.0	41.0	26.0	31.0	32.0	33.0	27.0	29.0		N/A

(1) - ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-SD-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMITS BASED UPON 0% MOISTURE "LOW LEVEL" SOIL MATRIX, INDIVIDUAL SAMPLE LIMITS ARE ADJUSTED ACCORDINGLY.

* DETECTED IN LABORATORY Q.C. BLANK.

N/A - NOT APPLICABLE

TABLE 4 CONTINUED
SEDIMENT SAMPLES
INORGANIC ANALYTICAL SUMMARY
IONIA CITY LANDFILL

PARAMETER	SAMPLE ID NUMBER (1) CONCENTRATION AS ug/Kg (ppm)									FIELD BLANK 000-02	DETECTION LIMIT (2)
	018-02	019-02	020-02	021-02	022-02	023-02	024-02	025-02	025-04		
ALUMINUM	7780.0	9680.0	4020.0	9180.0	4230.0	4900.0	7430.0	1960.0	6150.0	--	20.0
ANTIMONY	--	--	--	--	--	--	--	--	--	--	6.0
ARSENIC	15.0	15.0	--	17.0	--	12.0	13.0	--	6.8	--	1.0
BARIUM	85.0	57.0	74.0	137.0	49.0	73.0	96.0	--	38.0	--	20.0
BERYLLIUM	--	--	--	--	--	--	--	--	--	--	0.5
CADMIUM	1.9	2.2	1.9	2.0	2.6	2.2	2.4	0.82	1.4	--	0.5
CALCIUM	24500.0	73000.0	41400.0	28500.0	33200.0	38900.0	39100.0	19300.0	20900.0	--	500.0
CHROMIUM	14.0	16.0	11.0	16.0	11.0	19.0	13.0	4.4	13.0	--	1.0
COBALT	7.9	8.2	--	10.0	--	--	--	--	--	--	5.0
COPPER	13.0	9.9	12.0	6.3	7.8	14.0	4.7	4.6	--	--	2.5
IRON	28800.0	19300.0	13900.0	35000.0	11300.0	14700.0	19700.0	7290.0	11100.0	--	10.0
LEAD	74.0	17.0	21.0	12.0	18.0	29.0	13.0	14.0	27.0	--	0.5
MAGNESIUM	10600.0	24800.0	9700.0	17000.0	--	8980.0	12000.0	--	--	--	500.0
MANGANESE	442.0	409.0	510.0	1220.0	214.0	535.0	907.0	442.0	350.0	--	1.5
MERCURY	0.28	0.14	0.22	0.16	--	0.17	0.16	--	--	--	0.02
NICKEL	21.0	20.0	15.0	23.0	11.0	28.0	16.0	6.7	12.0	--	4.0
POTASSIUM	764.0	1370.0	--	--	--	--	773.0	--	737.0	--	500.0
SELENIUM	--	--	--	--	--	--	--	--	--	--	0.5
SILVER	--	--	--	--	--	--	--	--	--	--	1.0
SODIUM	--	--	--	--	--	--	--	--	--	--	500.0
THALLIUM	--	--	--	--	--	--	--	--	--	--	1.0
VANADIUM	16.0	15.0	--	21.0	8.2	9.4	16.0	8.6	15.0	--	5.0
ZINC	166.0	42.0	95.0	66.0	46.0	65.0	49.0	29.0	63.0	--	2.0
pH	7.5	7.6	7.6	7.7	7.7	7.7	7.1	6.5	7.2		N/A
PERCENT SOLID	70.0	72.0	59.0	74.0	69.0	68.0	67.0	73.0	71.0		N/A

(1) - SAMPLE ID NUMBER REPRESENTS LAST 5 DIGITS OF THE NOMENCLATURE ICL-SW-XXX-XX.

(2) - CONTRACT REQUIRED DETECTION LIMITS BASED ON 100% SOLID, "LOW LEVEL" SOIL MATRIX.

N/A - NOT APPLICABLE

7.12

development of property(ies) adjacent to the Site is unlikely due their location in the floodplain of the Grand River.

VI. SUMMARY OF SITE RISKS

CERCLA requires that U.S. EPA protect human health and the environment from current and potential exposure to hazardous substances found at and near the Site. An Endangerment Assessment (EA) was prepared by the PRPs and their consultant as part of the RI/FS. The objective of the EA was to determine the magnitude and probability of actual or potential harm to public health from exposure to contaminants released from the Site. This was accomplished by evaluating the chemicals detected during the site investigation to determine the contaminants of concern. Environmental factors, i.e., geology, hydrogeology, hydrology and climatology and the associated site features were then evaluated to determine migration pathways. Finally, the potential for endangerment to identified subpopulations was estimated by comparing the exposure, i.e., dose, to established guidelines and limits.

The results of the EA indicated that the ingestion of contaminated shallow groundwater presents an unacceptable noncarcinogenic and carcinogenic risk to both adults and children. The risks associated with the indicator compounds via all remaining exposure scenarios were found to be within acceptable levels.

A. Contaminant Identification

The following contaminants, which were detected during the site investigation, were determined to be the indicator compounds upon which the EA was based.

1. vinyl chloride
2. methylene chloride
3. 1,1-dichloroethane
4. trans-1,2-dichloroethene
5. 1,1,1-trichloroethane
6. butyl benzyl phthalate
7. cadmium
8. chromium
9. manganese
10. selenium
11. silver

Table 5 summarizes the rationale for selection of the indicator compounds present at the Site.

8.a

TABLE 5

RATIONALE FOR FINAL INDICATOR COMPOUND SELECTION

IONIA CITY LANDFILL

1. Vinyl chloride was selected due to frequency of detection and high PC/NC ranking.

2. 1,1 Dichloroethane was selected due to a high NC ranking.

3. Trans 1,2 dichloroethene was selected due to a high NC ranking.

4. Toluene was not selected since it was detected in both upgradient and downgradient soil samples and upwind and downwind air samples in approximately the same frequency and magnitude.

5. Methylene chloride was selected since it is a probable carcinogen, detected in groundwater and detected in the source area.

6. 1,1,1 Trichloroethene was selected since it was detected in the Area A trench sample, and it was the most representative compound detected in the air monitoring samples.

7. Ethylbenzene was not selected since it was only detected in the Area A trench samples.

8. Barium was not selected since it was observed in the upgradient and downgradient groundwater and surface water samples in the same frequency and magnitude, and the soil concentrations were below typical background concentrations.

9. Selenium was selected due to a high NC ranking and its presence in groundwater above MCLs.

10. Mercury was not selected since it was not detected in the surface water or groundwater, and it was not frequently observed in the soil matrix.

11. Lead was not selected since it was not detected in the surface water (except the upstream sample), it was detected only one time in the groundwater samples (below the MCL), and it was observed in the upgradient and downgradient soil boring and sediment samples in approximately the same frequency and magnitude.

12. Cadmium was selected since it was detected in the surface water, the groundwater above the MCL, and the soil matrix above typical background levels. It was also detected in the point source.

13. Manganese was selected since it was detected frequently in the groundwater at concentrations greater than the drinking water standards.

14. Silver was selected since it was detected in both the groundwater and soil matrix samples.

15. Chromium was selected since it was detected in the groundwater above the MCLs and in the source above the typical background soil range.

Note: Butyl benzyl phthalate was selected as the most representative compound of the semi-volatile organics since it was frequently detected in Area A and the soil matrix samples.

B. Exposure Assessment

Six exposure scenarios were identified through which populations could potentially become exposed to the indicator compounds detected at the Site. The scenarios include:

1. Ingestion of contaminated shallow groundwater,
2. Ingestion of contaminated soils,
3. Dermal exposure to contaminated soils,
4. Inhalation of volatile organics,
5. Incidental ingestion of contaminated surface water, and
6. Ingestion of contaminated fish.

Populations potentially at risk are primarily located in a light commercial and residential area immediately north of the Site. Undeveloped property, owned by the City of Ionia, is located to the east of the Site; a recreational area to the west-northwest; agricultural land to the west and southwest; and the Grand River to the south. The area south of the Grand River is sparsely populated, with development comprised of individual residences and commercial and recreational facilities. Figure 2 depicts each of these areas on a land use map. Based on U.S. Census information, data from the City of Ionia and the USGS quadrangle map, it is estimated that the 1988 population within a one mile radius of the Site is 3,508.

The potential human exposure associated with each indicator compound was evaluated relative to each identified exposure scenario and population. The evaluation resulted in an estimated future exposure dose, expressed in terms of intake, which is the amount of substance taken into the body per unit body weight per unit time. Exposure doses were calculated based upon maximum and average (geometric mean) concentrations for an affected media and exposure pathway to determine the representative daily intakes, i.e. chronic or subchronic, adult or child.

Ingestion of shallow contaminated groundwater represents the primary potential exposure pathway of concern at the Site and will be the only scenario discussed in detail in this section. The assumptions made for the purpose of the exposure assessment for groundwater included:

* consumption of 2 liters per day for an adult and 1 liter per day for a child;

* body weight of 70 kg for an adult and 10 kg for a child;

* 100 percent absorption;

* frequency of contact of 365 days per year; and

* exposure duration of 25 years over a life time of 70 years.

Sampling of the shallow groundwater downgradient of the Site resulted in the detection of 9 of the 11 indicator compounds. The compounds and the representative and maximum concentrations are presented below.

DOWNGRADIENT GROUNDWATER CONCENTRATIONS:
SHALLOW AQUIFER ONLY

Compound	Avg. (geometric mean) (ug/l)	Max. (ug/l)
Vinyl Chloride	6.93	86
Methylene Chloride	1.10	1
1,1 Dichloroethane	2.55	26
Trans-1,2 Dichloroethene	2.86	31
Cadmium	4.51	22
Chromium	2.74	186
Manganese	202.03	897
Selenium	2.48	12
Silver	2.06	8

The limits of the plume have been defined as the Grand River immediately south of the Site, extending from the western boundaries in a south-southwesterly direction. As previously illustrated on Figure 8, the plume has extended past Cleveland Street and onto the property west of the landfill. The majority of the property is inundated with the flood waters of the Grand River every Spring. Based upon the direction of groundwater flow, no other properties would be impacted by the plume, due to it's expected discharge into the Grand River.

At present there is no potential for the ingestion of contaminated groundwater since no wells, except for the monitoring wells installed during the site investigation, exist between the Site and the discharge point of the shallow aquifer, the Grand River. The likelihood of future use of the shallow aquifer in this area in minimal due to seasonal flooding of the Site and surrounding area, and current and projected land use of the Site and adjacent properties impacted by contaminated groundwater. It is anticipated that institutional controls will completely eliminate the possibility of this exposure scenario; however, for purposes of the exposure assessment this cannot be assumed.

Table 6 presents estimated chronic exposure doses for adults and children. U.S. EPA standard parameters for intakes, body weights and frequency of contact were used to account for incremental water ingestion away from home. Concentrations used for these calculations are representative of the concentrations observed during the monitoring of the shallow A-1 aquifer and of a worst case ingestion concentration.

c. Risk Characterization

The purpose of the risk characterization is to assess the potential risks of the 9 indicator compounds detected in groundwater relative to the groundwater exposure scenario. Risk levels were determined by comparing

phe-1

TABLE 6

ESTIMATED ADULT CHRONIC EXPOSURE DOSES FOR INGESTION OF CONTAMINATED GROUNDWATER

CHEMICAL	Adult Human Intake Factor (l/kg/day)	Worst Case Concentration (mg/l)	Most Probable Case Concentration (mg/l)	Worst Case Chronic Daily Intake (mg/kg/day)	Most Probable Case Chronic Daily Intake (mg/kg/day)
VINYL CHLORIDE	2.9 E-2	8.6 E-2	6.9 E-3	2.5 E-3	2.0 E-4
METHYLENE CHLORIDE	2.9 E-2	1.0 E-3	1.1 E-3	2.9 E-5	3.2 E-5
1,1 DICHLOROETHANE	2.9 E-2	2.6 E-2	2.6 E-3	7.5 E-4	7.5 E-5
TRANS 1,2 DICHLOROETHENE	2.9 E-2	3.1 E-2	2.9 E-3	9.0 E-4	8.4 E-5
CADMIUM	2.9 E-2	2.2 E-2	4.5 E-3	6.4 E-4	1.3 E-4
CHROMIUM	2.9 E-2	1.9 E-1	2.7 E-3	5.5 E-3	7.8 E-5
MANGANESE	2.9 E-2	9.0 E-1	2.0 E-1	2.6 E-2	5.8 E-3
SELENIUM	2.9 E-2	1.2 E-2	2.5 E-3	3.5 E-4	7.3 E-5
SILVER	2.9 E-2	8.0 E-3	2.1 E-3	2.3 E-4	6.1 E-5

1. Human Intake Factor = standard drinking water intake per day/standard body weight
2. Chronic Daily Intake = CDI = Concentration x Human Intake Factor
3. The geometric (most probable case) and maximum (worst case) shallow groundwater concentrations upon which the exposure doses are based are presented in Table 3-5.

10.2

TABLE 6 CONTINUED

ESTIMATED CHILD CHRONIC EXPOSURE DOSES FOR
INGESTION OF CONTAMINATED GROUNDWATER

CHEMICAL	Child Human Intake Factor (l/kg/day)	Worst Case Concentration (mg/l)	Most Probable Case Concentration (mg/l)	Worst Case Chronic Daily Intake (mg/kg/day)	Most Probable Case Chronic Daily Intake (mg/kg/day)
VINYL CHLORIDE	0.1	8.6 E-2	6.9 E-3	8.6 E-3	6.9 E-4
METHYLENE CHLORIDE	0.1	1.0 E-3	1.1 E-3	1.0 E-4	1.1 E-4
1,1, DICHLOROETHANE	0.1	2.6 E-2	2.6 E-3	2.6 E-3	2.6 E-4
TRANS 1,2 DICHLOROETHENE	0.1	3.1 E-2	2.9 E-3	3.1 E-3	2.9 E-4
CADMIUM	0.1	2.2 E-2	4.5 E-3	2.2 E-3	4.5 E-4
CHROMIUM	0.1	1.9 E-1	2.7 E-3	1.9 E-2	2.7 E-4
MANGANESE	0.1	9.0 E-1	2.0 E-1	9.0 E-2	2.0 E-2
SELENIUM	0.1	1.2 E-2	2.5 E-3	1.2 E-3	2.5 E-4
SILVER	0.1	8.0 E-3	2.1 E-3	8.0 E-4	2.1 E-4

1. Human Intake Factor = standard drinking water intake per day/standard body weight
2. Chronic Daily Intake - CDI = Concentration x Human Intake Factor
3. The geometric (most probable case) and maximum (worst case) groundwater concentrations upon which these exposure doses are based are presented in Table 3-5.

projected intakes and reference levels for noncarcinogens and comparing calculated risks and target risks for potential carcinogens.

To determine the noncarcinogenic risk, the hazard index (HI) for each applicable indicator compound was calculated. The HI is the ratio between the estimated exposure dose for each contaminant and the acceptable exposure level for the same contaminant, expressed as:

HI = estimated exposure dose / acceptable exposure level

A ratio of greater than unity (one) indicates an unacceptable risk.

The carcinogenic risks were quantified by calculating the incremental risk associated with the average lifetime dose of the contaminant. The formula used for the calculations is as follows:

Carcinogenic risk = carcinogenic potency factor x average lifetime dose

The factors used for the reference levels and target risks were established by U.S. EPA, while the projected intakes and calculated risks were determined per procedures established in the Superfund Public Health Evaluation Manual (U.S. EPA 1986a) and the Exposure Factors Handbook (draft, U.S. EPA 1987).

The exposure doses for ingestion of contaminated groundwater for adult and child population presented in Table 6 were used to calculate both the carcinogenic and noncarcinogenic risks.

The acceptable exposure levels for each compound are included in Table 7. (Table 7 includes exposure levels expressed in terms of acceptable intakes-subchronic (AIS) and acceptable intakes-chronic (AIC).) A HI of greater than one indicates an unacceptable risk. As indicated on Table 8, the ratios for methylene chloride, trans-1,2 dichloroethene, manganese and selenium are less than one in both the worst case and most probable case scenarios. However, for both adults and children, there is an unacceptable noncarcinogenic risk in the worst case scenario, due to cadmium and chromium exposure doses. The chromium HI calculation for the worst case scenario was based on a one-time maximum value of 186 ug/l, which contrasts with the geometric mean of 2.74 ug/L. The cadmium HI calculation for, the worst case situation was based on a one-time maximum value of 22 ug/l, which contrasts with the geometric mean of 4.51 ug/l. Furthermore, with the exception of the maximum value, all cadmium concentrations were at or below the National Primary Drinking Water Standard of 10 ug/l.

It should also be noted that an AIC for vinyl chloride has not been established due to the fact that as a carcinogen, there is no acceptable level. Consequently, a vinyl chloride HI was not calculated. Additionally, AICs have not been established for either trans-1,2-dichloroethene or silver.

The carcinogenic risk posed by ingestion of the shallow groundwater was determined by calculating the incremental risk associated with the average

TABLE 7

SUMMARY OF INGESTION TOXICITY VALUES
FOR THE INDICATOR COMPOUNDS

CHEMICAL	AIS (1) (mg/kg/day)	AIC (2) (mg/kg/day)	PF (3)
VINYL CHLORIDE	Not Given	Not Given	2.3 E+0
METHYLENE CHLORIDE (DICHLOROMETHANE)	6 E-2	6 E-2	7.5 E-3
1,1 DICHLOROETHANE	1 E+0	1 E-1	9.1 E-2
1,1,1 TRICHLOROETHANE	9 E-1	9 E-2	N/A
TRANS 1,2 DICHLOROETHENE	Not Given	Not Given	N/A
CADMIUM	Not Given	1 E-3 (food) 5 E-4 (water)	N/A
CHROMIUM	2 E-2	5 E-3	N/A
MANGANESE	5 E-1	2 E-1	N/A
SELENIUM	4 E-3	3 E-3	N/A
SILVER	Not Given	Not Given	N/A
BUTYL BENZYL PHTHALATE	2 E+0	2 E-1	N/A

1. AIS = Allowable Intake - Subchronic
2. AIC = Allowable Intake - Chronic
3. PF = Carcinogenic Potency Factor

All toxicity values, i.e., AIS, AIC and PF, obtained from U.S. EPA's Health Effects Assessment Summary Table: Second Quarter FY 1989.

TABLE 8

ADULT RISK CHARACTERIZATION (1) FOR INGESTION
OF GROUNDWATER: NONCARCINOGENIC EFFECTS

CHEMICAL	Worst Case CDI (mg/kg/day)	Most Probable Case CDI (mg/kg/day)	HAZARD INDEX		
			ACCEPTABLE DOSE (2)	WORST CASE	MOST PROBABLE CASE
VINYL CHLORIDE	2.5 E-3	2.0 E-4	Not Given	(3)	(3)
METHYLENE CHLORIDE	2.9 E-5	3.2 E-5	6 E-2	4.8 E-4	5.3 E-4
1,1 DICHLOROETHANE	7.5 E-4	7.5 E-5	1 E-1	7.5 E-3	7.5 E-4
TRANS 1,2 DICHLOROETHENE	9.0 E-4	8.4 E-5	Not Given	(3)	(3)
CADMIUM	6.4 E-4	1.3 E-4	5 E-4	1.3	2.6 E-1
CHROMIUM	5.5 E-3	7.8 E-5	5 E-3	1.1	1.6 E-2
MANGANESE	2.6 E-2	5.8 E-3	2 E-1	1.3 E-1	2.9 E-2
SELENIUM	3.5 E-4	7.3 E-5	3 E-3	1.2 E-1	2.4 E-2
SILVER	2.3 E-4	6.1 E-5	Not Given	(3)	(3)
		Sum of HIs - Worst Case - 2.7			
		Sum of HIs - Most Probable Case - 3.3 E-1			

Refer to Table 3-6 for Exposure Doses

1. Risk characterization for noncarcinogens is presented as a Hazard Index which is the ratio of the estimated exposure dose to acceptable dose.
2. Acceptable Dose = Allowable Intake - Chronic (AIC) as presented in Table 5-1.
3. The Hazard Index cannot be calculated since an acceptable dose has not been established.

11.6

TABLE 8 CONTINUED

CHILD RISK CHARACTERIZATION (1) FOR INGESTION OF GROUNDWATER: NONCARCINOGENIC EFFECTS

CHEMICAL	Worst Case CDI (mg/kg/day)	Most Probable Case CDI (mg/kg/day)	ACCEPTABLE DOSE (2)	HAZARD INDEX	
				WORST CASE	MOST PROBABLE CASE
VINYL CHLORIDE	8.6 E-3	6.9 E-4	Not Given	(3)	(3)
METHYLENE CHLORIDE	1.0 E-4	1.1 E-4	6 E-2	1.7 E-3	1.8 E-3
1,1 DICHLOROETHANE	2.6 E-3	2.6 E-4	1 E-1	2.6 E-2	2.6 E-3
TRANS 1,2 DICHLOROETHENE	3.1 E-3	2.9 E-4	Not Given	(3)	(3)
CADMIUM	2.2 E-3	4.5 E-4	5 E-4	4.4	9.0 E-1
CHROMIUM	1.9 E-2	2.7 E-4	5 E-3	3.8	5.4 E-2
MANGANESE	9.0 E-2	2.0 E-2	2 E-1	4.5 E-1	1.0 E-1
SELENIUM	1.2 E-3	2.5 E-4	3 E-3	4.0 E-1	8.3 E-2
SILVER	8.0 E-4	2.1 E-4	Not Given	(3)	(3)
			Sum of HIs - Worst Case - 9.1		
			Sum of HIs - Most Probable Case - 1.1		

Refer to Table 3-7 for Exposure Doses

1. Risk characterization for noncarcinogens is presented as a Hazard Index which is the ratio of the estimated exposure dose to acceptable dose.
2. Acceptable Dose = Allowable Intake - Chronic (AIC) as presented in Table 5-1.
3. The Hazard Index cannot be calculated since an acceptable dose has not been established.

lifetime dose of vinyl chloride, methylene chloride, and 1,1-dichloroethane. A value of 25 years was utilized as the reasonable worst case estimate to represent the time spent at one residence (U.S. EPA 1987; Contract No. 68-02-4254). Cancer risks were calculated for both adults and children for both the worst case and most probable cases. As indicated on Table 9, the ingestion of shallow groundwater presents a lifetime cancer risk greater than the EPA point of departure of 10^{-6} cancer risk (1 cancer per million population) for vinyl chloride and 1,1 dichloroethane.

VII. DESCRIPTION OF ALTERNATIVES

The major objective of the FS was to evaluate remedial alternatives consistent with the goals and objectives of CERCLA, as amended by SARA. The alternatives evaluated in the FS were divided into actions considered for either the point source or groundwater pathways. These alternatives are discussed in detail in the FS report and with some modifications, are summarized below. Changes were made in the Proposed Plan to establish a true No Action alternative for both the point source and groundwater pathways, and to separate monitoring of the point source area from long-term monitoring of the entire Site. With the exception of the No Action alternative, elements of each of the point source alternatives include limited access to the Site, repair of degraded soil cover, implementing institutional controls to prevent actions at affected properties which might increase the release or potential release of hazardous substances to the environment or endanger public health, and point source monitoring. Point source monitoring will entail the installation of at least three monitoring wells into the shallow aquifer immediately downgradient and sidegradient of the point source area to monitor point source loading, if present, to the shallow groundwater following remediation. These elements are included in the construction and O & M costs of each point source alternative.

Based on the findings of the RI, Area B poses no risks to human health and the environment therefore, remediation beyond upgrading the soil cover and side slopes is not necessary.

A. Point Source Alternatives

ALTERNATIVE 1 - NO ACTION
The No Action alternative is evaluated as a requirement of the NCP. Under this alternative, no further action would be taken at the Site. There are no associated costs for this alternative.

ALTERNATIVE 2 - PARTIAL EXCAVATION WITH OFF-SITE INCINERATION
Under this alternative, the point source would be excavated and transported to an approved off-site facility for incineration.

During operations, worker dermal and respiratory protection equipment would be required. Dust suppression measures would have to be implemented to reduce the potential for off-site migration of contaminated particulates.

TABLE 9

ESTIMATED ADULT INCREMENTAL CARCINOGENIC RISK (1) ASSOCIATED WITH INGESTING CONTAMINATED GROUNDWATER

CHEMICAL	Frequency (2)	Worst Case CDI (mg/kg/day)	Most Probable Case CDI (mg/kg/day)	Carcinogenic Potency Factor (mg/kg/day)-1	Worst Case Incremental Risk	Most Probable Case Incremental Risk
VINYL CHLORIDE	0.36	2.5 E-3	2.0 E-4	2.3 E+0	2 E-3	2 E-4
METHYLENE CHLORIDE	0.36	2.? E-5	3.2 E-5	7.5 E-3	8 E-8	9 E-8
1,1 DICHLOROETHANE	0.36	7.5 E-6	7.5 E-5	9.1 E-2	2 E-5	2 E-6
		Sum of Adult Incremental Risk - Worst Case - 2 E-3				
		Sum of Adult Incremental Risk - Most Probable Case = 2 E-4				

Refer to Table 3-6 for exposure doses.

1. Incremental Carcinogenic Risk = Estimated Lifetime Dose (CDI x Frequency) x Carcinogenic Potency Factor.

2. Frequency = Estimated Exposure (365 days/year x 25 years/70 year lifetime).

12.a

TABLE 9 CONTINUED

ESTIMATED CHILD INCREMENTAL CARCINOGENIC RISK (1) ASSOCIATED WITH INGESTING CONTAMINATED GROUNDWATER

CHEMICAL	Frequency (2)	Worst Case CDI (mg/kg/day)	Most Probable Case CDI (mg/kg/day)	Carcinogenic Potency Factor (mg/kg/day)-1	Worst Case Incremental Risk	Most Probable Case Incremental Risk
VINYL CHLORIDE	0.36	8.6 E-3	6.9 E-4	2.3 E+0	7 E-3	6 E-4
METHYLENE CHLORIDE	0.36	1.0 E-4	1.1 E-4	7.5 E-3	3 E-7	3 E-7
1,1 DICHLOROETHANE	0.36	2.6 E-3	2.6 E-4	9.1 E-2	9 E-5	9 E-6
		Sum of Child Incremental Risk - Worst Case - 7 E-3				
		Sum of Child Incremental Risk - Most Probable Case = 6 E-4				

Refer to Table 3-7 for exposure doses.

1. Incremental Carcinogenic Risk = Estimated Lifetime Dose (CDI x Frequency) x Carcinogenic Potency Factor.

2. Frequency = Estimated Exposure (365 days/year x 25 years/70 year lifetime).

9.2

The majority of the waste (contaminated soil and deteriorated drums) could be excavated and handled using conventional excavation equipment i.e., backhoes, front-end loaders, dozers. To meet material handling requirements at the closest RCRA-approved, CERCLA compliant incinerator (at this time, Chemical Waste Management, Chicago, IL.) this bulk excavated material would have to be processed through a shredder and packaged into 20 gallon fiberpacks. Based on estimated bulk waste volumes, over 73,000 fiberpacks would be required.

Intact drums would be recovered using a backhoe equipped with a drum grappler attachment. Each drum would be sampled, the contents categorized in an on-site lab, then either overpacked or bulked for transportation to the incineration facility. Approximately, 340 trailer loads would be required to transport the fiberpacked bulk waste and overpacked drums to the incineration facility. To complete the project, the excavated area would be backfilled and seeded for revegetation.

Approximately nine months would be required to complete the project, with the majority of on-site effort spent conducting fiberpacking operations. Significant delays could occur if incinerator availability is limited or delayed.

Estimated Construction Costs	$20,027,075
Estimated Annual O & M Costs	$51,000
Estimated Implementation Time Frame for Remedial Action	8 to 12 months
Estimated 10 Year Present Worth	$20,340,650

ALTERNATIVE 3 - IN-SITU VITRIFICATION (ISV)
Under this alternative, electrodes are placed in the ground and an electric current melts the soil and pyrolyzes or destroys organic materials. During the process, metallic and other inorganic contaminants are dissolved into or are encapsulated in the vitrified mass. Gasses evolved from the melt would be recovered by an off-gas collection system placed over the area. These off-gases would then be routed through a scrubber system. When the electric current ceases, the molten mass cools and solidifies into a glass-like material that will permanently retain its physical and chemical integrity.

Based on information from the vendor, Geosafe Corporation, production rates of approximately 5 tons per hour are expected. Generally, operations are conducted 24 hours per day, seven days per week utilizing four crews. Normally, on a large scale job, an area selected for vitrification is processed (vitrified) for four days then the equipment is moved to a different location on the site (requiring about 16 hours) and operations reinitiated. Once the vitrified mass cools, the area would be backfilled and seeded for revegetation. Engineering-scale tests will be required to determine the site specific design and operating parameters prior to full-scale implementation.

Presently, there is only one commercially available vitrification system; however, according to Geosafe, additional systems are on order and should be available for use in the near term. In the event that scheduling problems are encountered, a complete ISV system can be manufactured, tested and made ready for field operations in approximately 6 months. Furthermore, according to Geosafe, a client can enter into a contract to guarantee availability of a system at the anticipated start date.

Estimated Construction Costs	$3,261,050
Estimated Annual O & M Costs, Yr. 1	$112,750
Estimated Annual O & M, Yrs 2-10	$51,000
Estimated Implementation Time Frame for Remedial Action	4 to 8 months
Estimated 10 year Present Worth	$3,630,525

Alternative 4 - PARTIAL EXCAVATION WITH ON-SITE INCINERATION
Under this alternative, the point source would be excavated and treated in an on-site incinerator to thermally destroy contaminants.

Mobile on-site incineration units applicable to this site are available from several vendors. Technologies include rotary kiln, circulating bed and infrared systems. In general, the waste excavation and drum handling procedures described previously in the off-site incineration alternative would remain unchanged. The contaminated soil and drum remnants would be shredded and fed into the primary oxidation chamber which heats the soils to a sufficient operating temperature (1500-2000^{o} F) to drive off and initiate destruction of hydrocarbon contaminants. Inorganic contaminants would not be destroyed by this process. The treated soils then fall to a temperature quench prior to their exit from the unit.

Gases from the primary oxidation chamber are further oxidized in a secondary chamber. This chamber affords a retention time (one to two seconds at approximately 2000^{o} F) to ensure complete destruction. Liquids recovered at the Site can be destroyed by directly injecting them into this chamber. Exhaust gases are routed to air pollution control devices consisting of flue gas coolers, particulate removal systems and wet scrubbers before being released to the atmosphere.

After incineration, the treated soils and ash would be tested in accordance with standard EPA toxicity tests to determine if they are acceptable for use as backfill in the excavated area of the Site or if they must be classified as a hazardous waste. If the ash cannot be delisted, it will require handling and off-site disposal as a hazardous waste resulting in significantly higher costs than if it were used as fill. To complete the project, the excavated area would be backfilled (with the delisted material and/or imported soil) and seeded for revegetation. An incineration system sized for this site would process approximately 100 tons per day. Total on-site time including mobilization, rig-up, site preparation, excavation and waste processing, and demobilization would require approximately five months.

Estimated Construction Costs	$5,004,350
Estimated Annual O & M Costs	$51,000
Estimated Implementation Time Frame for Remedial Action	4 to 8 months
Estimated 10 Year Present Worth	$5,317,750

Alternative 5 - PARTIAL EXCAVATION WITH OFF-SITE LANDFILL
As described in the other partial removal alternatives, worker dermal and respiratory protection equipment and dust suppression measures would be required to prevent exposure during waste handling activities.

Excavation of the majority of waste would be achieved using normal earth moving equipment. If stabilization of the waste to enhance handling characteristics is required, the appropriate stabilizing agent (i.e., portland cement, cement kiln dust) would be mixed with the waste using this equipment. The bulk waste would be loaded onto dump trailers, the trailers properly tarped and manifested and then dispatched to the approved landfill.

Intact drum recovery and handling procedures would be identical to those described in the off-site incineration alternative. Overpacked drums and liquids capable of being bulked would be transported to an approved facility for incineration. On completion of removal operations, the excavated area would be backfilled and seeded for revegetation.

Total time required to complete on-site operations is estimated to be three to six months. Approximately 316 dump trailer loads would be required to transport the bulk waste to the landfill while an additional 8-15 loads of overpacked drums and bulk liquids are estimated.

Estimated Construction Costs	$3,163,375
Estimated Annual O & M Costs	$51,000
Estimated Implementation Time Frame for Remedial Action	3 to 6 months
Estimated 10 Year Present Worth	$3,477,050

Each point source alternative discussed above, with the exception of the No Action alternative, will permanently eliminate the toxicity and mobility of hazardous substances at the Site. Alternatives 2,3 and 5 will eliminate volume at the Site by removal, whereas Alternative 3 will reduce volume by in-situ treatment. As the point source is wholly situated within a landfill consisting of a refuse-soil matrix, establishing action levels for "soils" to determine the volume of removal or extent of in-situ treatment is not an objective of point source remediation. The extent of the source area (and extent of remediation) is based solely on RI field tasks which verified the vertical and lateral limits of buried drums, associated wastes and contaminated soils in Area A. It is acknowledged that residual contamination likely exists within the fill area and subsoils throughout the remaining portions of Area A and Area B; however, based on the operating history of the Site, it is believed the point source is the primary portion of the Site significantly contributing to groundwater contamination. A decision on any further groundwater action is deferred

until the completion of the monitoring program and will be documented in an Record of Decision (ROD) for groundwater, which in conjunction with this ROD, constitutes the final remedy for the Site.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In order to determine the most appropriate point source alternative that is protective of human health and the environment, attains ARARs, is cost-effective and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, point source alternatives were evaluated against each other. Comparisons are based on the nine criteria outlined in SARA.

1. Overall Protection of Human Health and the Environment.

All point source alternatives, with the exception of the No Action alternative, would provide adequate protection of human health and the environment, since they result in permanent remediation of the source area through removal and/or treatment. The source area has been well defined from the field activities performed during the RI. No other source areas have been identified. Complete remediation of the source area will protect the groundwater from future risk of contamination.

Alternative 3, ISV, is the most preferred alternative since the treatment of the source area occurs in-situ. In-situ treatment avoids potential exposures to human health and the environment resulting from excavation of the source area and other waste handling procedures necessary to implement other point source alternatives.

Alternative 4, partial excavation with on-site incineration, is the next preferred alternative. Potential exposures to human health and the environment may occur, but will be limited to excavation and loading of materials into the feeder of the incinerator at a controlled pace. Air monitoring will be conducted during excavation and waste handling activities to insure that on-site personnel are wearing appropriate protective clothing. Monitoring will also determine the need to modify or discontinue on-site work if action levels are exceeded.

Alternative 2, partial excavation with off-site incineration, would be the next preferred alternative. Although similar, Alternative 4 is preferred over this alternative because off-site incineration expands the potential waste handling exposures from on-site to those which may occur during transportation and at the off-site facility.

The least preferred source alternative is Alternative 5, partial excavation with off-site disposal. The risks posed by the contaminants in the source area are not eliminated, but simply transported to another location.

2. Compliance with ARARs

All point source alternatives, except the No Action alternative, will comply with all identified applicable or relevant and appropriate Federal and State requirements (ARARs) which are outlined in Section XI, Statutory Determinations.

All point source alternatives involving excavation must comply with the Floodplain Management Act, Executive Order (EO) 11988, since the Site is situated within the 100 year floodplain of the Grand River. Alternative 3, ISV, which involves in-situ treatment will comply with the Order. As the contingency remedy involves excavation of the source area, it may have to address the provisions of EO 11988 which would require protection of the excavation activities from a 500-year flood event.

In addition to ARARs, U.S. EPA's policy on the use of facilities for off-site disposal is "to be considered." U.S. EPA's off-site policy states that wastes from a Superfund site can only be sent to a facility in compliance with their existing RCRA permit. Since facilities can shift in and out of compliance, the specific facility where waste will be shipped will not be determined until the remedial action is scheduled to begin. Alternative 5, which uses off-site facilities, is the least preferred alternative because of disposal uncertainties regarding facility compliance. If the incinerator ash from Alternatives 2 and 4 is hazardous, it will similarly be subject to U.S. EPA's off-site policy requirements.

A potential ARAR for CERCLA responses is the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions (LDRs). The LDRs prohibit land disposal of restricted RCRA hazardous wastes unless the wastes meet treatment standards, minimum technology requirements during a capacity extension or satisfy the requirements of one of the other available compliance options. Because the selected point source alternative employs in-situ treatment, LDRs are neither applicable nor relevant and appropriate. LDRs will be a significant factor under Alternative 5, partial excavation and off-site disposal. For this reason, Alternative 5 is the least preferred point source alternative.

3. Long-term Effectiveness and Permanence

The point source Alternatives 2, 3 and 4, which utilize ISV and incineration technologies, are expected to achieve long-term effectiveness and permanence in remediating the source area. Incineration is a well proven and widely used technology. ISV is an innovative technology, with its full scale use predicated on a treatability study at the Site to assure that the soil-waste matrix within the source area is vitrifiable. Incineration will produce an ash in which inorganic contaminants will be concentrated. The ash will have to be tested, and if necessary, treated and properly disposed. ISV, if effective, will produce a glass-like material similar to volcanic obsidian. Inorganic contamination will be encapsulated in this glass material. Therefore, with respect to inorganic contamination, ISV, or Alternative 3, is preferred over the incineration

technologies of Alternatives 2 and 4. Alternative 5 is the least preferred alternative since the contamination levels in the source area are not reduced through treatment, and will remain as a risk in a new location.

4. Reduction of Toxicity, Mobility or Volume through Treatment

Alternatives 2, 3, and 4 utilize treatment technologies, incineration and ISV, that reduce the toxicity, mobility and volume of contaminants. Incineration results in greater than a 99.9999% reduction in organic contaminants; however, incineration does not address inorganic contamination. Inorganics are concentrated in the ash as a byproduct of incineration. Inorganics can leach out of the ash, unless the ash is further treated and properly disposed. A volume reduction of approximately 25% occurs. Alternative 3, ISV also results in greater than a 99.9999% reduction of organic contaminants through initial pyrolyzation, followed by treatment of off-gases produced during the melt. Unlike incineration, ISV encapsulates inorganics within the vitrified mass formed after the melt. In pilot studies, the vitrified soil blocks were found to have a leach rate of 1×10^{-5} g/cm^2/day. This rate is comparable to that of Pyrex glass and much less than rates for marble or bottle glass. A volume reduction of between 20-40% and greater can occur depending on the initial void space of the soil-waste matrix.

Because of the ability of ISV to encapsulate inorganic contaminants, and with greater volume reduction than incineration, Alternative 3, ISV, is preferred over incineration technology alternatives. Alternative 5, partial excavation with off-site disposal is the least preferred alternative since no reduction in toxicity, mobility or volume occurs.

5. Short-term effectiveness

Short-term effectiveness is assessed through risks to public health and the environment generated by implementation of the remedial action and the length of time before the remedial action can be implemented to address the principal threat caused by the Site.

All of the point source alternatives, with the exception of the No Action Alternative, present potential short term risks to on-site workers and the community during implementation. The incineration alternatives and Alternative 5 involve excavation of the point source area. Excavation of this area may produce releases of organic vapors as waste materials and contaminated soils are exposed to air. Trenching activities conducted during the RI in the source area generated significant organic vapors. As during the trenching operations, on-site personnel will wear appropriate protective clothing during remediation. Air monitoring will be performed at the site boundary to assess the level of organic vapors. If the levels detected through sampling exceed action levels, then on-site activities would be modified or discontinued.

Alternative 3, ISV, may produce short term air releases during operation depending on the levels of contamination in the soil-waste matrix to be vitrified. The initial pyrolysis of organic contaminants will be 99.9% to

99.995% complete. The remainder of this organic mass (less than 0.1%) is volatilized and captured by the off-gas treatment system. A high concentration of contaminants in one area (i.e. intact drums) may cause an internal explosion that will saturate the off-gas treatment system. A release of carbon dioxide, water and trace amounts of organic vapors could occur. A pilot study performed prior to full scale implementation work will evaluate this potential risk in greater detail and corrective action will be incorporated into the final design as appropriate. At the present, site specific information does not indicate the existence of large numbers of intact drums. Trenching activities conducted during the RI revealed that many of the drums encountered were in poor condition and not intact; however, some intact drums containing liquids were observed.

ISV would take the least amount of time to implement, and once implemented should be complete in approximately 60-90 days. This period would be increased by the time required for an on-site pilot test and subsequent evaluation of its applicability to site conditions. The next preferred alternative with respect to shortest implementation time is Alternative 5, since it involves only excavation and disposal without any time for treatment as required for the incineration technologies. Of the two incineration technologies, Alternative 4, on-site incineration, is the next preferred alternative because there are fewer waste handling requirements.

6. Implementability

All of the point source alternatives are implementable: however, the source area is in the 100 year floodplain of the Grand River. Therefore, all point source alternatives, with the exception of no-action, will have to be implemented during periods when the water table is below the maximum depth of buried drums.

The incineration technologies of Alternatives 2 and 4 are conventional, well demonstrated, and have a large commercial experience base. Alternative 2, off-site incineration, requires incinerator capacity dedicated to this project for approximately 9 months. If incinerator capacity cannot be guaranteed, or significant downtime is experienced; then the wastes would either have to be stored on-site or transported to another facility. Alternative 4, on-site incineration, requires a mobile incineration unit for implementation. Mobile incinerator units are available from several vendors. Although an operational permit is not required, a trial burn will have to be completed to ensure the 99.9999% destruction efficiency for the wastes will be obtained.

The ISV technology of alternative 3 is classified by U.S. EPA as an innovative technology: one that has been developed to large scale and is ready for commercial deployment, but for which there is not a significant commercial experience base. Because of this status, it is necessary to evaluate thoroughly all aspects of ISV applicability through a treatability study prior to commitment to large scale operation. A treatability study can be completed in 6 to 10 weeks and would be used to demonstrate the applicability of ISV to the soil waste matrix, and to generate operational performance data needed to support remedial design. Only one vendor and one full scale commercial ISV unit is available at the present. However, a complete ISV system can be manufactured, tested and made ready for

operations in approximately 6 months once a contract is entered into with the vendor.

Because the point source treatment alternatives require some degree of difficulty in implementation, Alternative 5, off-site disposal, with no treatment would be the easiest to implement. Both Alternative 4, on-site incineration and Alternative 3, ISV, have equal degrees of difficulty in implementation. The treatability study for ISV is easier to complete than the trial burn for on-site incineration. However, a chance that the treatability study will demonstrate unsuitability for ISV exists; whereas a trial burn is expected to be successful over time after the correct engineering adjustments are made to the unit. Alternative 4, off-site incineration, is the least preferred treatment alternative, since guaranteed incinerator capacity for 9 months is almost impossible to secure.

7. Cost

The cost of each point source alternative has been estimated based upon capital, and operation and maintenance costs. Alternative 3, ISV, and Alternative 5, partial excavation with off-site landfill, are the least costly, with Alternative 5 costing approximately $150,000 less. However, the off-site disposal provisions of Alternative 5 counter any cost benefits associated with its implementation. Alternative 4, on-site incineration, costs approximately one-third more than Alternative 5. Alternative 2, off-site incineration, is 6 times as costly as Alternative 4, and is the least preferred alternative.

8. State Acceptance

The State of Michigan has participated in the project as a support agency. The State supports this point source remedial action.

9. Community Acceptance

The City of Ionia and the community have not expressed a preference for any of the alternatives. There were no written comments received during the public comment period. Two oral comments were received during the public meeting. The first comment was from Mr. Russ Gregory, Editor of the Ionia Centinel Standard. His comment concerned the role of the Army Corps of Engineers in the remedy selection process and specific requirements that may have to be met for activities conducted in a floodplain. He suggested ISV might constitute construction activities and would therefore be subject to the Corps' approval prior to implementation. In response to his comment, September 20, 1989 correspondence from the Corps of Engineers' Detroit District office provided their comments on the final Proposed Plan and Draft Record of Decision for the Site. Construction within the floodplain of the Grand River is not an issue; however, any remedial action must be in compliance with Executive Order (EO) 11988, Flood Plain Management, where applicable. In the event the contingency remedy is implemented, excavation of the source area should include measures to protect excavation activities from a 500-year flood event. U.S. EPA and

MDNR will coordinate with the Army Corps to insure that any remedial activities as the Site comply with applicable elements of EO 11988.

The second comment was from John McNamara, an attorney for the City of Ionia. He felt he had not had sufficient time to review the recently added information to the repositories. To the best of his knowledge the material was not made available at either repository until late last Friday (August 25, 1989). In response to his comment, it is true that the repository received the proposed plan, administrative index and feasibility study during the week of August 21, 1989; however, the public comment period continued until September 18, 1989. Any comments received by U.S. EPA that were postmarked no later than September 18, 1989 were formally responded to and included in the administrative record for the Site. Generally, the U.S. EPA will extend the public comment period if requested; however no such request was received. Secondly, the City of Ionia is not new to the Site. As past operator and past and present owner of the Site, the City of Ionia is a PRP. The City undertook a removal of exposed drums in Area A of the Site in 1984-85 under the terms of an Administrative Order issued by U.S. EPA. They were formally notified as a PRP in 1985 and, along with other PRPs, were invited to conduct the RI/FS at the Site. Whereas two PRPs did conduct the investigation, the City elected not to participate. The MDNR has prepared and released progress reports throughout the RI/FS process to update interested parties and City officials on the status and progress of the investigation. The two repositories have also been updated, as necessary, during the course of the RI/FS.

Summary of Comparison

Under Alternative 1, No Action, the point source would not be remediated and would continue to contaminate the shallow aquifer and pose a risk to the Grand River. Given the nature and location of the Site, the No Action Alternative is not consistent with the objectives for remedial action, and is not a viable option.

Alternative 5, partial excavation and off-site disposal would be the most easily implementable alternative and is the least costly. However, it does not meet the statutory preference for treatment, and does not reduce the toxicity, mobility and volume of contaminants. In addition, it may not comply with the Land Ban Requirements under RCRA.

Even though Alternative 2, off-site incineration, and Alternative 4, on-site incineration, offer the same treatment technologies, Alternative 4 is preferred because it is conducted entirely on-site which minimizes waste handling (packaging and transportation). In addition, the costs associated with Alternative 2 are four times the cost of Alternative 4. On these bases, Alternative 2 is eliminated from further consideration.

The two remaining alternatives for the point source are Alternative 3, ISV, and Alternative 4, on-site incineration. While incineration is the more established and demonstrated technology, ISV will result in a greater reduction in toxicity, mobility and volume of contaminants than incineration because of the encapsulation of inorganics with no residual

ash that will likely require off-site disposal. ISV will also provide greater long term effectiveness and permanence. In addition, overall protection of human health and the environment is enhanced through in-situ treatment which minimizes waste handling and organic vapor releases associated with excavation activities. ISV is the least costly treatment alternative, and upon completion of a successful pilot study will remediate the source area in the shortest time period. For these reasons, Alternative 3, ISV, is the preferred alternative.

IX. THE SELECTED REMEDY

Section 121 of SARA requires all remedies for Superfund sites to be protective of human health and the environment, comply with ARARs, be cost-effective and utilize permanent solutions and alternate treatment technologies to the maximum extent practicable. As this operable unit remedial action only addresses the point source area at the Site, Alternative 3 is believed to provide the best balance among alternatives with respect to the criteria used to evaluate remedies.

The major components of the selected remedy for the point source are:

* ISV of the defined point source area and an adjacent margin of safety zone;

* fencing the Site to restrict access (repairing the fence in Area A and installing a fence along Cleveland Street in Area B);

* placement of at least 3 monitoring wells in the shallow A-1 aquifer immediately downgradient and sidegradient of the point source area to assess completeness of point source remediation and monitor future release, if any, of contaminants to the groundwater from the point source;

* institutional controls to restrict the use of the Site and, if appropriate, adjacent properties from activities that would potentially endanger public health or threaten the environment;

* upgrading the landfill cover and repairing side slopes, as needed, followed by revegetation to minimize future erosion and insure the integrity of the landfill cap.

Full scale implementation of ISV is contingent on successful on-site implementation of an engineering scale pilot test that insures ISV's applicability to existing site conditions, e.g. soil types, moisture levels, depth interval of wastes materials, waste types and other environmental and site specific factors. Specific performance criteria of the pilot test will be established to demonstrate the ability of ISV to: 1) vitrify the point source; 2) prevent contaminant migration in soils and beyond the area of vitrification; and 3) provide the necessary destruction efficiency in the off-gas collection and treatment system. The pilot test will also provide information as to the need for modifying the operating

procedures prior to full scale implementation. U.S. EPA's Superfund Innovative Technology Evaluation (SITE) Program, developed out of the Office of Solid Waste & Emergency Response and Office of Research and Development, has expressed considerable interest in the application of ISV to conditions such as those that exist at the Site. They have indicated the desire to provide input during the design, implementation and evaluation of the pilot test if the remedy is undertaken by the PRPs. In addition, they are interested in performing environmental monitoring tasks during the pilot test. Detailed costs associated with ISV are presented in Table 10.

As previously discussed, the vertical and lateral extent of the point source area has been defined by two trenching events during the RI. During remedial design and in conjunction with the pilot test, an appropriate safety zone will be identified beyond the defined point source area and will be included in the area subject to vitrification to insure complete remediation. Furthermore, the vitrified safety zone will serve as a containment barrier which, when keyed into the lower permeability unit underlying the buried drums, will fully encapsulate the point source area.

The placement of monitoring wells immediately downgradient of the point source area is a critical component of the selected remedy. Assuming the point source is the primary area contributing to groundwater contamination, and given they hydraulic characteristics of the shallow A-1 aquifer, the impact of point source remediation on groundwater should be immediate.

Prior to the pilot test, a minimum of 3 monitoring wells will be installed in the shallow aquifer immediately downgradient and sidegradient of the source area, and outside of the expected limits of vitrification. These wells will be sampled monthly for two months to establish base levels and target compounds for future analyses since there is no data from this close to the source area. If the pilot test is successful, immediately prior to full scale implementation the point source monitoring wells will be sampled a third time and analyzed for the selected target compounds. At the completion of the remedial action, samples will be collected monthly for a period of no less than nine months. All samples will be analyzed for the target compounds. After the nine month period, the data will be basis for selecting an appropriate remedial action for the contaminant plume. This will culminate in a ROD for the groundwater operable unit, which in conjunction with the point source ROD, constitutes the final remedy for the Site.

It is believed that institutional controls can successfully be implemented at and near the Site. Even in the absence of institutional controls, it can be demonstrated that future development of the Site is unlikely. Based on present land use, the City of Ionia zoning district map, and the geographic setting of the Site, no drinking water wells are anticipated at any point in the future.

In the event results from the on-site pilot test demonstrate that ISV will not provide the necessary level of remediation pursuant to the performance criteria, U.S. EPA intends to implement the contingency remedial

TABLE 10

PRESENT WORTH COST SUMMARY FOR IN-SITU VITRIFICATION

CAPITAL EXPENDITURE ITEM	COST
1. Mobilization/Demobilization/Rig-up	$ 193,000
2. Remove/Stockpile Overburden	6,000
3. Vitrification Operations	2,263,000
4. Backfill/Contour/Revegetate	20,000
5. Repair/Upgrade of Fencing	6,000
6. Signs	3,200
7. Deed Restrictions	2,000
8. Repairs to Landfill Cover	10,000
9. Installation of 3 Monitoring Wells	7,500
SUBTOTAL	$2,510,700
ENGINEERING/TREATABILITY STUDIES (10% OF CAPITAL COSTS FOR ITEMS 1-4)	248,200
CONTINGENCY ALLOWANCES (20% OF CAPITAL COST)	502,150
TOTAL CAPITAL COSTS	**$3,261,050**
ANNUAL O&M COSTS	COSTS ($/YEAR)
Year 1	$ 112,750
Years 2-10	51,000
PRESENT WORTH AT 10% FOR 10 YEARS	**$3,630,525**

alternative on-site incineration, after appropriate Agency guidance has been followed. Major components of the point source contingency remedy are:

* complete excavation of the point source area with treatment in an on-site incinerator to thermally destroy contaminants;

* limiting site access, groundwater monitoring, institutional controls and upgrading landfill cover as specified in the selected remedy.

Target clean-up levels for the soil-refuse matrix to determine the extent of excavation will not be established. The extent of excavation will be based on the extent of buried drums. Sampling may be required to insure removal of all grossly contaminated soils from the buried drum deposit. The point source monitoring program will be the basis for determining the need for additional point source remedial activities.

Following construction of an on-site mobile incinerator facility, a trial burn is required prior to full-scale operations. If extensive trial burns are required to obtain necessary permitting, the remedial action start-up date would be delayed.

Residual wastes from incineration include ash which will be tested in accordance with standard EPA toxicity tests. If the ash is non hazardous, it may be acceptable for use as backfill in the excavated area; however, if the ash is hazardous, it must be transported to an approved off-site disposal facility. Detailed cost estimates for on-site incineration are presented in Table 11.

X. EXPLANATION OF SIGNIFICANT DIFFERENCES

Unlike the Proposed Plan, this remedial action is limited to an operable unit for the point source area. A final decision on groundwater is deferred until completion of the groundwater monitoring program.

XI. STATUTORY DETERMINATIONS

Under its legal authorities, U.S. EPA's primary responsibility at Superfund Sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this Site must comply with applicable or relevant and appropriate environmental regulations (ARARs) under Federal and State environmental laws, unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduces the volume,

TABLE 11

PRESENT WORTH COST SUMMARY FOR
PARTIAL REMOVAL WITH ON-SITE INCINERATION

CAPITAL EXPENDITURE ITEM	COST
1. Mobilization/Demobilization/Site Preparation	$ 585,000
2. Start Up	180,000
3. Excavation	153,000
4. Drum Handling Operations	224,000
5. Incineration Operations	2,550,000
6. Backfill/Revegetation	131,000
7. Repair/Upgrade of Fencing	6,000
8. Signs	3,200
9. Deed Restrictions	2,000
10. Repairs to Landfill Cover	10,000
11. Installation of 3 Monitoring Wells	7,500
SUBTOTAL	$3,851,700
ENGINEERING/PILOT STUDIES (10% OF CAPITAL COSTS FOR ITEMS 1-6)	382,300
CONTINGENCIES (20% OF CAPITAL COSTS)	770,350
TOTAL CAPITAL COSTS	**$5,004,350**
ANNUAL O&M COSTS	COSTS ($/YEAR)
YEARS 1-10	$ 51,000
PRESENT WORTH AT 10% FOR 10 YEARS	**$5,317,750**

toxicity, or mobility of hazardous substances pollutants and contaminants as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

The selected point source remedy protects human health and the environment through vitrifying the point source area of the Site. With ISV, an electric current melts the soil and destroys organic materials. During the process, metallic and other inorganic contaminants are dissolved into or are encapsulated in the vitrified mass.

After the point source is vitrified, the area will be backfilled and seeded for revegetation. Any threat to the population that may have been presented by the point source area will be eliminated. There will be no possibility of further ingestion of contaminated soils, and no further possibility of dermal exposure to contaminated soils after ISV is complete, and the area has been backfilled and seeded for revegetation. ISV also eliminates the identified source of contamination at the Site. During this period of remediation, human health will be further protected by the institutional controls that will effectively eliminate the possibility of future ingestion of the groundwater.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The selected point source remedy comply with ARARs. The ARARs for the point source remedy are presented below.

A. Federal Solid Waste and Disposal Act (Resource Conservation and Recovery Act - RCRA)

RCRA is not applicable to this Site since the Site was not used for disposal after 1980, the operative date for RCRA. However, Subpart G of RCRA, 40 CFR 265 is relevant and appropriate in implementing ISV at the Site, and the appropriate substantive requirements will be met. Subpart G outlines the requirements for closure and post-closure including monitoring. The area downgradient from the point source area, as well as the area downgradient of the landfill will be monitored, and this ARAR will be complied with.

B. Federal Clean Air Act

The Clean Air Act (CAA) identifies and regulates pollutants that could be released during melting associated with ISV. Section 109 of the CAA outlines the pollutants for which National Ambient Air Quality Standards have been established. Section 112 identifies pollutants for which there are no applicable Ambient Air Quality Standards, those substances regulated under the Federal National Emission Standards for Hazardous Pollutants. The CAA is an ARAR, and the regulation standards will not be exceeded during implementation of ISV.

C. Federal Executive Order - Floodplain Management - Executive Order No. 11988

Executive Order 11988 requires Federal agencies to evaluate the potential effects of actions that may be taken in a floodplain and measures to avoid the adverse impacts associated with direct and indirect development of a floodplain. The Site is located in a 100-year floodplain, so this Order is an ARAR. U.S. EPA will consult with the U.S. Army Corps of Engineers concerning the Order, and will comply with those elements of the Order which apply.

D. Michigan Hazardous Waste Management Act (Act 64)

Act 64 Part 6 Rule 607 specifies the closure and post-closure monitoring requirements. The appropriate substantive aspects of the monitoring requirements will be met.

E. Mineral Well Act (Act 315)

Act 315 and the Administrative Rules require that test wells be permitted, constructed properly, recorded, and properly plugged upon abandonment. This Act is an ARAR and treatment of all test wells will be dictated by it.

F. Michigan Air Pollution Act (Act 348)

Under this Act, the Michigan Air Quality Division, through Rule 901, exercises its authority to ensure that a person does not cause or permit the emission of an air contaminant in quantities that will cause, "injurious effects to human health or safety, animal life, plant life or significant economic value," or "unreasonable interference with the comfortable enjoyment of life and property." This Act is an ARAR which has more stringent emissions controls for air contaminants than the Federal Clean Air Act, and the substantive technical requirements will be complied with during the melting process associated with ISV.

Cost-Effectiveness

The selected point source remedy is cost-effective because it has been determined to provide overall effectiveness proportional to its costs, the net present worth being $3,630,525. The estimated cost of ISV is approximately one sixth the cost of Alternative 2, partial excavation with off-site incineration. The selected point source remedy eliminates the point source area as a source of contamination, while minimizing waste handling and potential exposure to on-site workers.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

U.S. EPA has determined that the selected point source remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in the most cost effective manner. Of those alternatives that are protective of human health and the environment and comply with

ARARs, U.S. EPA has determined that this selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, and cost, and also considers the statutory preference for treatment as a principal element.

ISV offers 99.9999% destruction of the wastes and contaminated soils in the point source area. The remaining material will be encapsulated in the vitrified mass and present no further threat to human health and the environment.

The selected point source remedy treats the principal threat posed by the point source, including eliminating the future release of contaminants to groundwater. All point source alternatives are effective in the short term; however once the pilot test is successfully completed, ISV can be easily implemented.

The selection of treatment of the point source is consistent with program expectations that indicate that toxic and potentially mobile waste are a priority for treatment and often necessary to ensure the long-term effectiveness of the remedy. Since all three treatment options are reasonable comparable with respect to long-term effectiveness, and toxicity and mobility reductions are achieved, the major tradeoffs that provide the basis for this selection decision are short-term effectiveness, implementability, cost, and overall protection of public health and the environment. Following a successful pilot test, the selected point source remedy can be implemented quickly, and with less difficulty than the other treatment alternatives and is therefore determined to be the most appropriate solution for the point source area at the Site.

Preference for Treatment

By vitrifying the point source area, the selected point source remedy addresses the principal threat posed by the Site through the use of treatment technologies. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied.

XII. RESPONSIVENESS SUMMARY

Two comments were received during the public comment period. The responses to these comments are found in Section VIII., Community Acceptance, on page 20.

Administrative Record

Index not included.